

Logistics Management Institute

# Assessment of ISO 9000 Pilot Program

U.S. Army Corps of Engineers



CE607R1



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*Logistics Management Institute*

# Assessment of ISO 9000 Pilot Program

U.S. Army Corps of Engineers 

CE607R1

November 1998

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## LOGISTICS MANAGEMENT INSTITUTE

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### Assessment of ISO 9000 Pilot Program: U.S. Army Corps of Engineers

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## Executive Summary

The U.S. Army Corps of Engineers (USACE) has a proud tradition of producing technically excellent products for the Army, its military partners, and the nation. Many of its civil works and military construction projects are recognized as technically advanced, state-of-the-art engineering achievements.

Because it wants to ensure that it continues to deliver quality products and services well into the future, the Corps has instituted a number of significant cultural, technical, and methodological improvements focusing on quality. However, it recognizes that it needs a *comprehensive* quality management system—a system that demonstrates to potential customers that the Corps is committed to providing quality products and services and that it has a bona fide quality management system in place to meet that commitment. The Corps concluded that the best tool to achieve those goals is the ISO 9000 quality management system.

To test the concept of operating under an ISO quality management system, USACE headquarters selected four engineering and two construction divisions to participate in a pilot program. On the basis of an assessment of the pilot program, LMI concluded that ISO 9000 registration offers valuable benefits to the Corps. Pilot organizations reported that their postregistration operations are streamlined, more efficient, and consistent with the operation of an engineering and construction organization. The rigor of maintaining registration is of value as well; it forces organizational self-examination in preparation for external audits. Registration is just the initial step; the positive effects of operating under an ISO 9000 quality system can be expected to continue indefinitely, not just immediately after implementation.

Less tangible, but equally worthy, is the effect of ISO 9000 on morale. ISO 9000 represents a positive cultural change. The divisions have found that operating under the ISO quality management system has improved internal communication, increased teamwork, improved the ability of individuals to see the big picture, reduced the time required to deal with routine procedures, clarified responsibilities, and reduced errors and rework. The benefits of operating under the ISO quality management system are undeniable. Although the organizations participating in

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the pilot program were enthusiastic about both the experience and the results of the ISO 9000 certification process, some viewed the time and cost of the process as too high. However, the Corps can take advantage of the lessons learned in the pilot program to improve the process. Specifically, to facilitate the implementation of ISO 9000 throughout the Corps, we recommend that USACE take the following steps:

- ◆ Adopt ISO 9000 as the Corps quality management standard, revising Engineering Regulation 1110-1-12 accordingly.
- ◆ Direct all engineering and construction divisions to achieve and maintain registration to the ISO 9000 standard.
- ◆ Develop customized training materials.
- ◆ Create a model policy and procedures manual that all Corps organizations can use as a starting point for creating their own manuals.
- ◆ Form a headquarters working group to be the nerve center and clearing-house for ISO experience within the Corps.
- ◆ Develop performance metrics and continuous improvement measures to track progress at each division that achieves ISO certification.
- ◆ Establish a master contract with a single ISO registrar to reduce the time and cost of each division's procuring those services and to reap the advantages of having a registrar that is familiar with USACE and its operations.
- ◆ Begin concurrently implementing ISO quality management systems in multiple divisions within a district, including any division (such as programming and contracts) involved with delivering service to customers.
- ◆ Test application of ISO 9000 beyond the district level.
- ◆ Train major subordinate command quality assurance people in ISO internal auditing procedures.
- ◆ Apply electronic and Web technology for document control.

ISO 9000 is a tool that provides a framework from which organizations can strive toward continuous improvement and achieve excellence. By operating under a common ISO quality management system, USACE will be able to manage innovation effectively, respond appropriately to rapidly changing customer requirements, continually improve its processes, and gain the dedicated involvement of everyone in the organization. In short, it can become an organization that is satisfied only when customer requirements are always met and service expectations are surpassed.

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# Chapter 1

## Introduction

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The U.S. Army Corps of Engineers (USACE) has a proud tradition of producing technically excellent products for the Army, its military partners, and the nation. Many of its civil works and military construction projects are recognized as technically advanced, state-of-the art engineering achievements. However, in the early 1990s, the Corps began to sense that its customers were not always satisfied with its products. After investigating the reasons for this growing dissatisfaction, the Corps found that its customers now want more than the traditional focus on technical results—technical sufficiency is expected. USACE customers want their projects delivered on time, at a competitive price, and they want excellent service. In short, customers are demanding a higher level of quality in the engineering and construction management services they are purchasing from USACE.

The Corps' customers (clients and partners) are becoming increasingly discriminating buyers, largely because their budgets and the size of their technical staffs are shrinking and their schedules are compressed. These new realities have caused the Corps to reevaluate both its culture and its business and technical methods as it strives to improve its overall performance today and into the future.

USACE recognizes that its future—to be the world's premier engineering and construction management organization—depends on its ability to deliver quality products and services. That recognition is formalized in the Corps' strategic vision, issued in 1996 by Lieutenant General Joe N. Ballard, Commander, USACE, to become “a vital part of the Army; the Engineer team of choice—responding to our Nation's needs in peace and war; a values-based organization—respected, responsive and reliable.”

Moreover, Corps offices throughout the nation and overseas are accepting the concept that quality is delivered when its customers—not the Corps—perceive that it has been delivered. As a result of this culture change, the Corps is increasingly finding that it is building and sustaining better customer relationships.

The Corps has undertaken a number of initiatives to ensure that it consistently delivers quality products and services—that it meets customer expectations. It is making significant progress through its nationally recognized “partnering” leadership, first with its construction contractors, then with its architect-engineering (A-E) firms, and now with its customers. Through its partnering initiative, the Corps works closely with all parties involved in a project to identify and attain mutual goals and objectives.

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Other initiatives under way to improve the quality of Corps products and services include the following:

- ◆ Soliciting formal customer feedback on Corps performance. Many local Corps offices have done this in the past. Corporate emphasis is now directed at asking customers to provide information that will improve the Corps' service at all levels and in all customer-service areas. And most important, the Corps is emphasizing effective and timely follow-up on that information.
- ◆ Capitalizing on the availability of computer-aided design and drafting (CADD) technology. Its efforts in developing CADD standards, generic details, standard project designs, design discipline analyses, and design-review and lesson-learned tools are enabling it to produce even better engineering results, more quickly and at lower cost.
- ◆ Controlling direct engineering costs, departmental overhead, and general and administrative overhead. These initiatives are already reducing the Corps' design costs for military projects.
- ◆ Streamlining the complex processes related to civil works projects. The Corps has been able to reduce the time from project initiation to completion dramatically.
- ◆ Developing new policy and guidance to improve uniformity and timeliness and to enable innovation in the acquisition of A-E and construction services.

Although it has instituted significant cultural, technical, and methodological improvements focusing on quality, the Corps has recognized that it needs a *comprehensive* quality management system—a system that will enable it to make sure customers' requirements are fully understood before work begins, to provide customers with ongoing feedback during product development, to ensure that the finished product satisfies the requirements established and agreed to by both parties, and to provide a framework for systematically evaluating and improving its major processes. In short, the Corps needs a quality management system that demonstrates to potential customers that the Corps is committed to providing quality products and services and that it has a bona fide quality management system in place to meet that commitment. USACE senior managers believe that the best tool to achieve those goals is registration to the ISO 9000 quality management system.

## BACKGROUND

The ISO 9000 quality system was developed by the International Organization for Standardization to bring uniformity to the area of quality assurance.<sup>1</sup> Uniformity was needed because the number of quality standards being used throughout the world had proliferated; each country—and often each industry—had instituted its own quality standards as quality became more important to consumers. The large number of different quality standards made compliance with them problematic for many companies. Not only was it difficult and costly for companies to keep track of the wide range of requirements and regulations imposed by different customers, multinational firms often had to juggle conflicting regulations or face the fact they might not be able to sell products designed for one country in another because they did not meet that country's unique quality assurance standards.

First issued in 1987 and revised in 1994, the ISO quality system looks at the primary elements that contribute to a company's ability to provide the products and services that meet its customers' stated needs.<sup>2</sup> Those elements range from contract reviews with the customer, inspection and testing procedures, and employee training, to management's responsibility for and commitment to quality.

Companies can assure their customers that they have an effective quality management system by proving to an ISO registrar that they meet all applicable ISO 9000 requirements—that they have developed procedures that address all applicable elements and that they use them consistently. Third-party audits of a company's quality management system—audits conducted by independent registrars whose findings are acceptable to both the customer and the supplier—are the hallmark of ISO 9000.

That the system is effective has been reported by many companies that have undertaken the ISO 9000 certification process. In addition to satisfying their customers, companies operating under ISO 9000 say they have improved productivity and reduced the costs associated with inefficient operations and wasted efforts. ISO 9000 ensures that the organization does the right things right, the first time and all the time. Among the many significant benefits that are widely reported are

- ◆ better understanding of customer needs;

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<sup>1</sup> The IOS was founded shortly after the end of World War II to set uniform standards for products and thus advance international commerce. Since its founding, the IOS has issued more than 8,000 standards and technical reports. Each standard is assigned a numerical designation. The prefix—ISO, from the Greek *isos* meaning “equal”—was chosen to indicate that the standards would apply to all users equally, regardless of a company's size, its products, its services, or the country in which it is located.

<sup>2</sup> ISO standards are continually reviewed and are periodically revised and reissued. ISO 9000 is being expanded beyond the original manufacturing focus to service industries and software development and is expected to be aligned more closely with the precepts of continuous quality improvement and total quality management.

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- ◆ consistent performance;
  - ◆ provision of a framework for measuring performance and improving processes;
  - ◆ continuous improvement in efficiency and effectiveness;
  - ◆ enhancement of the ability to deal with a changing business environment; and
  - ◆ establishment of a unified, purposeful system composed of interrelated business processes.

A survey conducted in 1996 by the Construction Industry Research and Information Association confirmed those benefits. Surveyed companies also reported that having an effective quality management system has enabled them to

- ◆ clarify responsibilities,
- ◆ reduce errors,
- ◆ improve the flow of information,
- ◆ identify management issues early,
- ◆ reduce the time needed for routine matters, and
- ◆ improve production.<sup>3</sup>

Most benefits of operating under the ISO quality system are largely qualitative and generally are not easily quantified unless appropriate measures are carefully planned in advance. However, one quantitative measure is the dramatic growth in the number of U.S. companies that have become registered as complying with ISO 9000, which has leaped from 241 in 1992 to nearly 21,000 in 1998, as shown in Figure 1-1. This explosive rate of growth is expected to continue as more organizations learn about the benefits of ISO 9000.

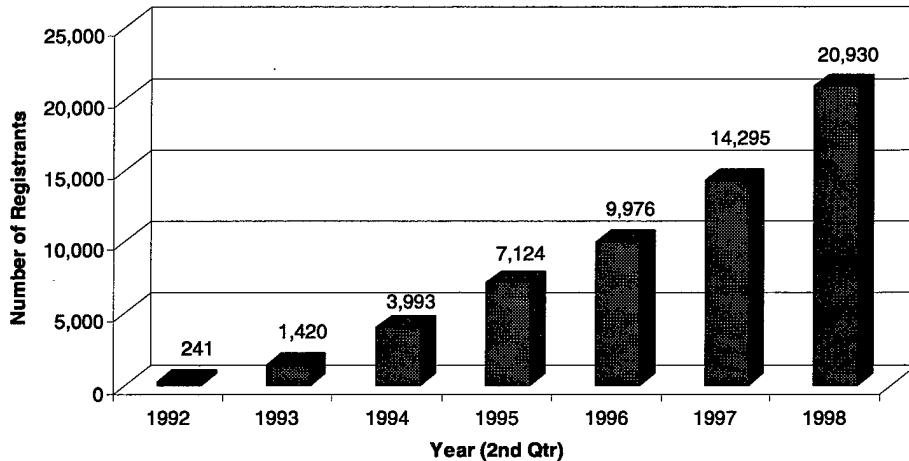
The companies attaining ISO 9000 registration are, to a large extent, manufacturing firms, but the standard is equally applicable to other types of businesses in the private sector (such as professional services firms), as well as to government organizations. For example, a large number of architectural, engineering, and construction firms—many of which are Corps partners—have become registered. Among them are Bechtel Group, Inc.; Brown and Root, Inc.; Fluor Daniel; Jacobs Engineering Group, Inc.; Raytheon Engineers and Constructors; and Stone and

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<sup>3</sup> Construction Industry Research and Information Association, *Quality Management in Construction—Survey of Experiences with BS 5750: Report of Key Findings*, Special Publication 132, London: CIRIA, 1996.

Webster Engineering Corporation. These companies are setting the pace for the industry.

*Figure 1-1. Number of U.S. Organizations with ISO 9000 Certification*



Source: "ISO 9000 Registrations Continue North American Climb," *Quality Systems Update*, July 1998, p. 1.

With several major engineering and construction firms already registered (and many more actively implementing ISO-compliant quality systems), industry experts believe that ISO 9000 registration may become a major factor in the selection of engineering and construction firms by customers in both the private and public sectors in the not-to-distant future. One example of a large project for which the contract specified that firms be registered as having an ISO quality system is the \$1.3 billion reconstruction of the I-15 corridor for the 2002 Olympics in Salt Lake City.

## USACE AND ISO 9000

Early work done by the Corps on ISO 9000 focused on interpreting how the ISO quality management system would apply to its engineering and construction activities and on developing a strategy for integrating its existing quality initiatives into the ISO quality system.<sup>4</sup> Recognizing the many potential advantages of adopting the ISO quality system, USACE headquarters selected four engineering and two construction field sites to participate in a pilot program to test the concept of quality system registration. USACE asked LMI to assist the field sites with the pilot program. LMI supplemented its staff with the Victoria Group, a firm that

<sup>4</sup> Logistics Management Institute, *Toward a World-Class Engineering Organization—Making ISO 9000 the Foundation to Quality Management*, Report CE308R1, Jeffrey A. Hawkins and James L. Hathaway, April 1994; *Road to Engineering Excellence: ISO 9000 Blueprint to Success*, Report CE308RD1, Jeffrey A. Hawkins, April 1995; *Construction Management Excellence: Using ISO 9000 to Improve Quality Systems*, Report CE501R1, Jeffrey A. Hawkins, November 1995.

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specializes in ISO 9000 consulting services. This report assesses the Corps' implementation of ISO 9000 at the six sites and the costs and benefits of doing so.

## REPORT ORGANIZATION

In Chapter 2 of the report, we briefly describe the ISO quality system and the typical ISO 9000 certification process. Chapter 3 discusses the approach taken by the Corps sites to become certified, as well as the approach we used to identify the costs and benefits of ISO 9000 certification. Our assessment of the pilot program, along with discussions of lessons learned, is contained in Chapter 4, and in Chapter 5, we present our conclusions about the applicability of the ISO quality system to the Corps and recommend some steps that USACE should take if it decides to implement ISO 9000 throughout the Corps.

## Chapter 2

# ISO 9000

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Many people in the Corps have heard of the ISO 9000 quality management system. But exactly what the system is, how it serves as a means to improve customer satisfaction, what the Corps must do to become registered as an ISO-compliant organization, and how an ISO quality system leads to improvement of USACE business processes are not well understood. In this chapter, we briefly discuss those concepts.

## ISO QUALITY SYSTEM

ISO 9000 comprises three different models, or standards, for quality management—ISO 9001, ISO 9002, and ISO 9003.<sup>1</sup> The standard with which an organization should comply depends on its functions. ISO 9001, the most comprehensive and rigorous of the ISO quality standards, is the model to be used by organizations involved in all aspects of producing a product, from design and development through production to installation and servicing; this model applies to USACE engineering activities. (*Product* includes services, processed materials, hardware, software, or a combination thereof, and may be tangible, such as processed materials, or intangible, such as knowledge or concepts.) ISO 9002 is the model to be used by organization's involved in production with no design function, such as USACE construction activities. ISO 9003 applies to inspection and testing organizations.

The ISO quality standards are based on a set of common functional elements that contribute to an organization's ability to meet its customer's expectations and to prevent deviations. Those elements, and a brief interpretation of them, are as follows:

1. *Management Responsibility.* The organization's management must be fully committed to establishing and maintaining a quality management system. It must have a quality policy and measurable business objectives, it must assign properly trained personnel, it must provide the resources necessary to implement its policy, and, periodically, it must review the progress being made toward achieving its stated quality policy and business objectives.

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<sup>1</sup> The ISO 9000 standards have their origins in both the United States and Europe. They share a common background with such standards as MIL-Q-9858, NATO AQAP1, and the British Standards Institutes series of quality standards (BS 5750).

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2. *Quality System.* The organization must develop, document, and implement policy, procedures, and appropriate work instructions covering each applicable element of the ISO quality management system.
  3. *Contract Review.* Before it agrees to any contractual arrangement with a customer, the organization must work closely with the customer to ensure that the customer's requirements are clearly defined, the roles of both parties are fully understood, the resources are available to fulfill the contract, and the organization can deliver the requested product or service.
  4. *Design Control.* At key stages during the design process (project conception through design completion), the organization must formally review the design to ensure that it will result in a product that meets the customer's requirements. The review must be done by appropriate technical professionals and customer representatives.
  5. *Document and Data Control.* The organization must ensure that staff members use only current documents (for example, plans showing the latest design changes) and data (current building codes) related to producing a quality product or service. That is, it must ensure that staffers never use invalid or obsolete documents. Applicable federal statutes, USACE engineering regulations and guide specifications, and project specifications, as well as quality system procedures, are examples of such documents. The organization also must ensure that all documents and data are readily available.
  6. *Purchasing.* Whenever it purchases goods and services needed to fulfill the contract with its customer, the organization must clearly define what is being purchased (for example, purchase orders must contain adequate technical data), ensure that the supplier is capable of delivering that needed product or service, and verify that what the supplier delivers conforms to what was ordered.
  7. *Control of Customer-Supplied Product.* The organization must ensure that it does not lose or damage any items supplied by the customer. Items received must be suitable for their intended use.
  8. *Product Identification and Traceability.* The organization must be able to readily identify its products for a particular customer during any stage of production, delivery, or installation. An effective identification system should enable the organization to track the development history of any product or service.
  9. *Process Control.* The organization must identify all business practices that can affect quality, and it must establish appropriate controls as well as provide the tools necessary to carry them out. These practices range from the availability of detailed procedures and work instructions and of appropriate equipment

(e.g., CADD systems) to the assignment of personnel to those projects that best take advantage of their knowledge, skill, and training.

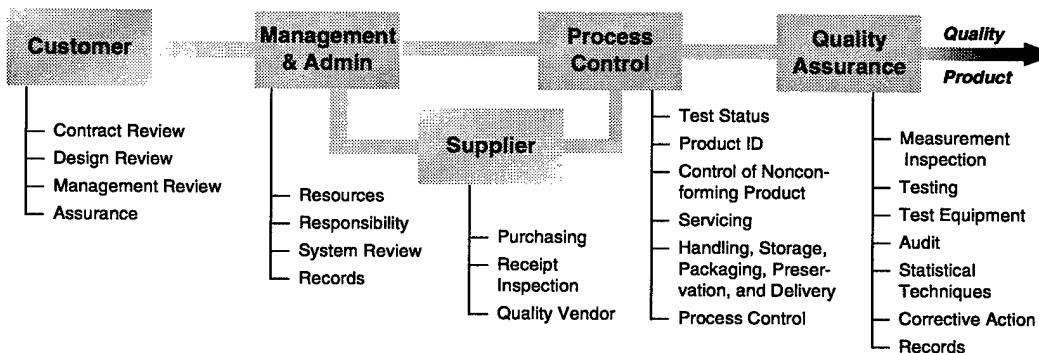
10. *Inspection and Testing.* To ensure that the completed product or service will be acceptable to the customer, the organization must set acceptance criteria, review all work—whether done in-house or by subcontractors—against those criteria, and specify the steps to be taken if the criteria are not met.
11. *Control of Inspection, Measuring, and Test Equipment.* The organization must use equipment that produces accurate results consistently; the equipment must meet internationally or nationally recognized standards for calibration.
12. *Inspection and Test Status.* The organization must have a system for identifying the pass/fail status of each product that it inspects or tests.
13. *Control of Nonconforming Product.* The organization must identify products that do not comply with the customer's requirements and must have procedures for handling those products.
14. *Corrective and Preventive Action.* The organization must take steps to prevent problems from recurring.
15. *Handling, Storage, Packaging, Preservation, and Delivery.* The organization must protect the product from being damaged or deteriorating before its delivery or use.
16. *Control of Quality Records.* The organization must have a documented system for effectively managing all quality records required by the ISO standard and its procedures.
17. *Internal Quality Audits.* Periodically, the organization must review its entire quality system to ensure that procedures are being consistently followed as documented.
18. *Training.* The organization must develop a plan for each employee that specifies what knowledge and training is appropriate for his or her job, and it must keep records of what training each employee has taken.
19. *Servicing.* The organization must service the product it delivers to the customer (if servicing is specified in the contract) and verify that it meets specified requirements.
20. *Statistical Techniques.* The organization must identify any processes that could benefit from the use of statistical techniques and, where appropriate, make sure the techniques employed are properly used.

Appendix A describes the elements in more detail, focusing on how they apply to USACE engineering and construction activities. A careful reading of the elements demonstrates that the ISO quality management system “is not simply an inspection process to eliminate any parts or services that do not meet a specific set of requirements. Under ISO 9000, quality is ‘built in,’ not ‘inspected in.’”<sup>2</sup> Quality is not something you do, it is the way you do things and is the result of controlled processes.

The specific elements that an organization must address to become ISO certified vary from model to model. Organizations wishing to become certified as complying with ISO 9001 must address the requirements of all 20 elements, while those seeking ISO 9002 certification must address the requirements of 19 elements—all except design control. Otherwise, the ISO 9001 and ISO 9002 requirements are identical. In contrast, ISO 9003 is considerably less rigorous; organizations must address just 16 of the 20 elements, and the requirements for meeting most of the remaining elements are less stringent than those for ISO 9001 and 9002. (Because ISO 9003 does not apply to Corps activities, we do not discuss it further.)

The elements of the ISO quality management system should be considered as a whole and in the context of their functions and intent. Generally, the functions affect one of five different business components—customers, management and administration, suppliers (A-Es, contractors, vendors), process control, and quality assurance. This concept is illustrated in Figure 2-1.

*Figure 2-1. Relationship of ISO 9000 Elements to Business Components*



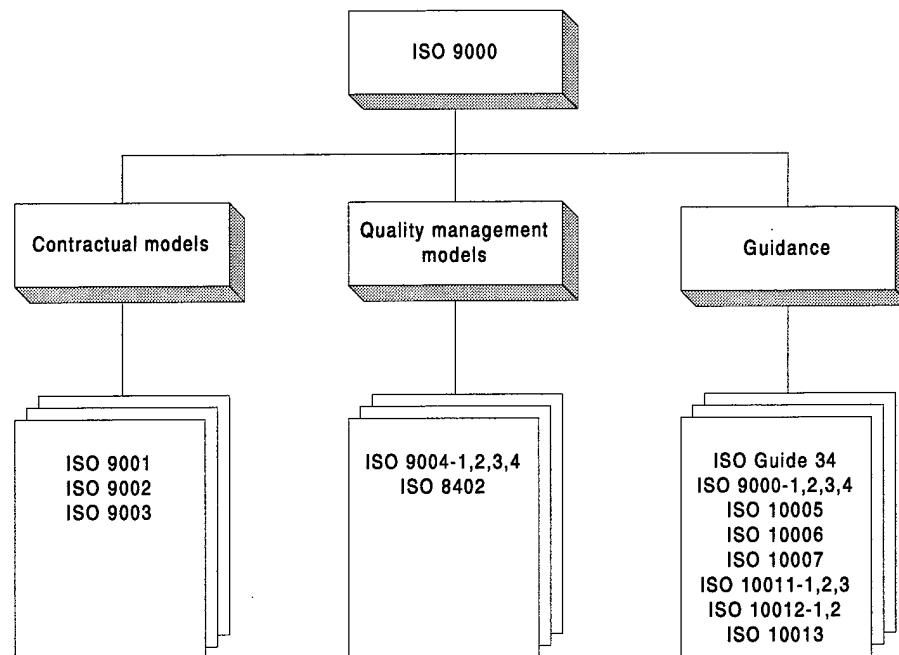
Source: ABS Integrated Services, Inc., Houston, TX.

Note: Some elements have functions that relate to more than one area. For example, management responsibility applies to the customer (management review) as well as to administration/management (resources and system review).

<sup>2</sup> Donald A. Sanders and C. Frank Scott, *How to Pass Your ISO Audit*, American Management Association, 1994, p. 4.

In addition to the standards describing the requirements of the three quality system models, ISO 9000 encompasses a number of other documents that contain additional information to help an organization establish and maintain its ISO-compliant quality system. The ISO 9000 family of models and guidance is depicted in Figure 2-2.

*Figure 2-2. ISO 9000 Family*



ISO 9001	Quality Systems—Model for Quality Assurance in Design, Development, Production, Installation, and Servicing
ISO 9002	Quality Systems—Model for Quality Assurance in Production, Installation, and Servicing
ISO 9003	Quality Systems—Model for Quality Assurance in Final Inspection and Test
ISO 9004 (Parts 1–4)	Quality Management and Quality System Elements (general guidelines and guidelines for services, processed materials, and quality improvement)
ISO 8402	Quality Management and Quality Assurance—Vocabulary
ISO Guide 34	Quality System Guidelines for the Production of Reference Materials
ISO 9000 (Parts 1–4)	Quality Management and Quality Assurance Standards (guidelines for selection, use, and application of ISO 9001, ISO 9002, and ISO 9003)
ISO 10005	Quality Management—Guidelines for Quality Plans
ISO 10006	Quality Management—Guidelines to Quality in Project Management
ISO 10007	Quality Management—Guidelines for Configuration Management
ISO 10011 (Parts 1–3)	Guidelines for Auditing Quality Systems (auditing, qualification criteria for auditors, and management of audit programs)
ISO 10012 (Parts 1–2)	Quality Assurance Requirements for Measuring Equipment (metrological confirmation system and guidelines for controlling measurement processes)
ISO 10013	Guidelines for Developing Quality Manuals

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Compliance with the standard ensures that the organization's management system addresses all of the potential sources of customer dissatisfaction. When all employees, including management, understand and fulfill their roles, the system becomes effective and serves the good of all. Using the system leads to reduced cost through systematic reduction of variation.

## REGISTRATION OF QUALITY SYSTEM

To become registered as having an ISO-compliant quality system, an organization must have processes in place that enable it to address the requirements of each applicable element. In addition, it must document those processes, and it must demonstrate that it follows them. In short, it must say what it does and do what it says. And the adequacy of its quality system must be assessed and periodically audited by an independent, accredited third party, known as a quality system registrar. When an organization's system conforms to the registrar's interpretation of the ISO 9000 standard, the registrar issues a "certificate of registration." The steps to establish an ISO quality system are described in the following subsections.

### Preparation of an ISO 9000 Project Management Plan

Once an organization decides to implement an ISO quality system, management should prepare a plan describing how the organization is going to get the job done. In addition, it should appoint and train a management representative and a management team.

### Identification of Quality System Processes

The next step is to analyze and define all of its existing processes and, where necessary, develop new processes. Organizations preparing for registration to the standard frequently wrestle with the question of what a process is. In ISO 9000, a process is a collection of activities that takes one or more inputs and creates an output that is of value to a customer. The set of activities required to build a house, the set of activities required to train a staff, and the set of activities required to conform to a particular ISO 9000 element are all processes.

Most organizations have business processes that address, at least to some extent, many of the ISO elements. However, those processes have evolved over several years, often in an effort to solve problems as they arise but also in response to management whim, legislative requirements, or other drivers. As a result, most organizations have processes with activities that do not add value and may in fact hinder efficiency or activities that are duplicated in more than one process. Developing an ISO quality system requires that the organization make a concerted effort to define each of its processes; it does not require business process reengineering. Typically, however, when an organization makes a concerted effort to identify and define all of its processes, it finds activities that do not add value, activities in one

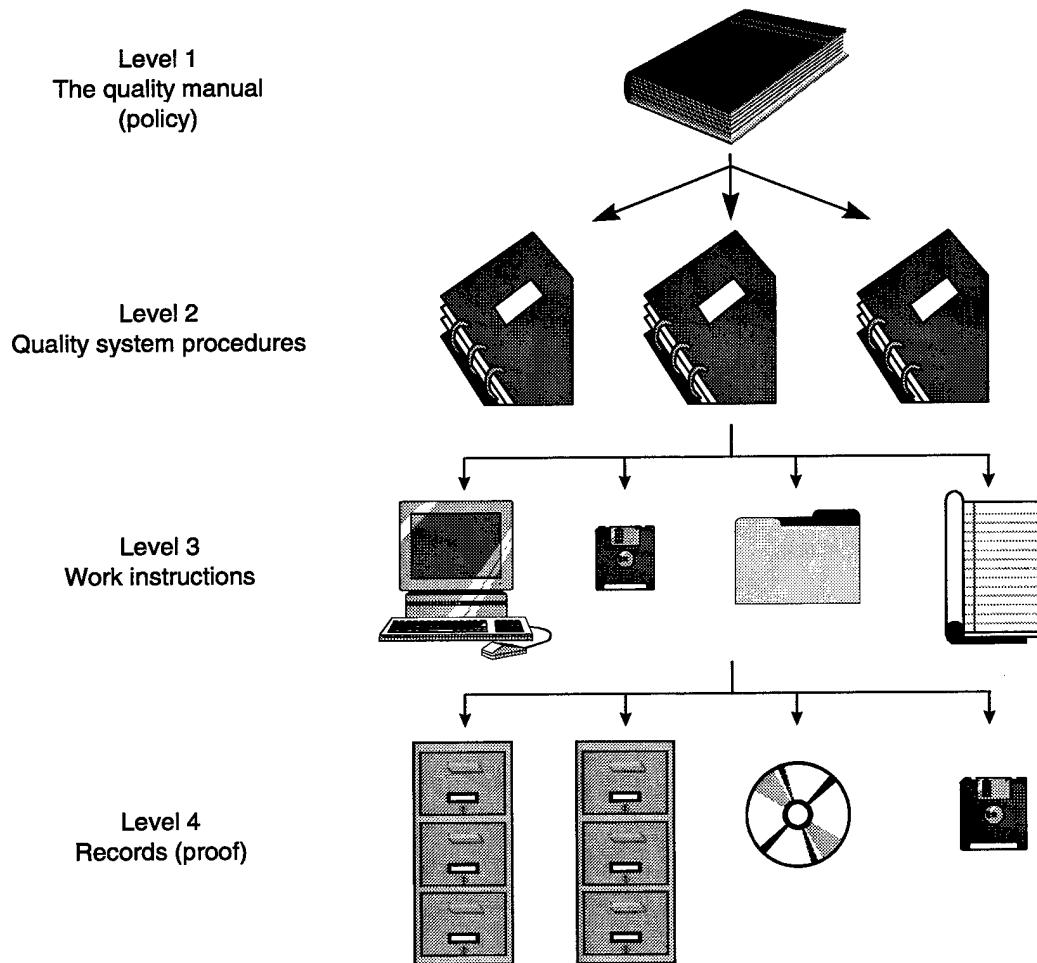
process that duplicate activities in another process, and other activities that can easily be adjusted to improve its processes.

## Documentation of Processes

After it has identified all of its processes, the organization must document them. Specifically, it must prepare documents describing what processes and procedures it uses to deliver the product or service, how quality is ensured, and how customer requirements are consistently met. Adequate documentation demonstrates to the third-party auditor that the quality system has been planned and that each element of the standard is sufficiently addressed. The documentation does not have to be onerous and should be appropriate for the situation. Too much documentation is more troublesome than not enough.

Figure 2-3 illustrates the four-level documentation structure suggested by the ISO 9000 standards.

*Figure 2-3. ISO 9000 Documentation Hierarchy*



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At the top of the documentation pyramid is quality policy as documented in a quality manual. The quality manual describes the organization's policy with respect to each applicable element and typically is 20 to 30 pages long. Level 2 documentation addresses the quality system procedures and should relate to the policy requirements as stated in the quality manual. While most of USACE's quality procedures are broadly described in directives and regulations, the ISO auditors will be concerned with how those regulations and statutes are implemented at the local level. The description of quality procedures does not need to be lengthy; it is enough to describe simply what is to be accomplished. Level 3, work instructions, deals with how each required procedure is to be accomplished. Those instructions form the bulk of the documentation. Not every procedure needs associated work instructions, but work instructions should be documented for any procedures directly affecting the quality of the work effort. Level 4 documentation comprises the records, or proof, that the organization has implemented practices in accordance with the stated quality policy and procedures.

An appropriate documentation system is the foundation for a successful quality management system and provides training in practiced procedures for new personnel to ensure consistency of performance.

## Implementation of Quality System

The next step is to implement the quality system as documented. The organization must train trainers, and it must train employees to ensure that they understand the quality system and how to operate under it.

The organization must then prove (usually verified through observation and quality records) that the personnel or systems responsible for executing its documented policies and procedures are doing so:

- ◆ The organization must have evidence that quality records have been established and that they are legitimate.
- ◆ The organization must evaluate the effectiveness of its processes with respect to its documented procedures and customer requirements. Typically, an organization selects and trains a group of employees to conduct periodic audits. The purpose of the audits is to provide opportunities for improvement and to review the quality system and to identify areas in which procedures are not being followed, not to point fingers but rather to enable the organization to learn what does not work as well as it could. The organization can then determine why the procedures are not being followed. For example, in some cases, employees may not be following a certain procedure because they think it is unimportant; in other cases, they may not understand what is required. Or the procedure itself may be inefficient or not accurately documented.

- ◆ When it identifies a problem, the organization must take appropriate action. That is, it must have a system for addressing and resolving current problems and preventing potential systemic problems. When warranted, that action should include changing existing procedures and updating relevant documentation. The process of identifying and correcting system deficiencies serves as a springboard for continual process improvement.
- ◆ Internal Auditors may also make a recommendation to improve a process even when they find that it is being followed as planned. Since auditors are independent of the processes they review, they may identify opportunities for improvement. Process revisions may not always be the result of an audit nonconformance.

When it operates with an ISO 9000-compliant system in place is when an organization begins to see the benefit of all of its work in documenting its processes. This phase can vary in length but needs to be long enough to document the results of operations, internal audits, and management review cycles (normally at least 6 months).

After the quality system has been in place and operating long enough to generate reports of internal audits, corrective and preventive action reports, and other evidence that it has been following the system, the organization should review the system. Typically, the system review is best done by the trainers. The system review's purpose is to make sure that the organization is ready to take the next step—apply for a certificate of registration.

## Third-Party Assessment

When management is confident the quality system is working, it selects an accredited registrar to assess its system.<sup>3</sup> The third-party assessment is intended to verify that the organization has documented and implemented a quality system that meets the requirements of the applicable standard, that the organization has objective evidence of its compliance with its documented system, and that the system is self-correcting and continuously improving. The third-party assessment has the following components: document review, preassessment audit, certification audit and report, corrective actions, and, ultimately, registration as being certified in compliance with the standard.

The registrar's services begin with a review of the quality system manual. This review is conducted from the registrar's office before an on-site preassessment audit. The combination of document review and preassessment audit is, in essence, a "feasibility" study to determine if the organization is ready for the

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<sup>3</sup> The role of the registrar is so important that we recommend that one company serve as the registrar for all districts so that it will be intimately familiar with USACE functions, constraints, and terminology, and so that guidance about an ISO quality system will be consistent across the Corps.

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full-blown certification audit. The information generated helps identify areas that, at a glance, may be weak or problematic and gives the organization the opportunity to make appropriate adjustments before the registrar does the formal audit.

The formal certification audit is an independent, systematic, and documented activity to evaluate, verify, and report on all aspects of the organization's compliance with the requirements of the standard. The audit includes observation of daily activities, interviews, and reviews of related records. After completing the audit, the registrar will write a report that lists the objective evidence of compliance with the requirements of the standard. The report also identifies areas of nonconformance and categorizes them as either minor or major. If too many areas of nonconformance exist, the auditors will recommend that the organization not be certified as ISO compliant. Otherwise, they may recommend that the organization be approved or that it receive conditional approval contingent on its correcting the areas of nonconformance. In the latter case, satisfying the auditors that corrective action has been taken in areas defined as nonconforming generally is accomplished without an additional on-site visit to the organization. The report is reviewed for conformance with the registrar's requirements and then the registrar issues a certificate of registration.

After receiving its certificate of registration, the organization must demonstrate, through periodic surveillance audits by the registrar, that it is continuing to use its quality system.

## ISO 9000 AS A VEHICLE FOR CONTINUOUS IMPROVEMENT

When an organization looks at how it does business in the context of the elements of the ISO quality system, it sees itself in a whole new light. In fact, the power of the standard is to a large extent the management discipline it requires and nurtures. In the hands of solid managers, the standard promotes an understanding of what is done and how it is accomplished, and it provides a structure for system reviews and corrective and preventive actions. That structure is the foundation necessary for continually improving.

Compliance with ISO 9000 ensures that the groundwork for good business practices is in place and forces organizational understanding and adherence to documented practices. By documenting its major processes, an organization is forced to consider and reach agreement on what those processes are, to identify the value-added steps, and to eliminate those that do not add value. It complements an organization's existing quality programs and encourages the organization to incrementally and continually improve its business processes through a system of identifying problems and taking corrective and preventive

actions. As the implemented system matures, the documented processes are examined and evaluated to identify more effective ways of doing business.

In short, ISO 9000 is a dynamic and comprehensive system that can be used by any organization to ensure the quality of its products and thus the satisfaction of its customer. Quality is not something you do; it is the way you do things and results from controlled processes. ISO 9000 is about managing the business in such a way that daily operations are continually improved, thus making the organization more competitive. The appealing aspect of the standard is that, by focusing on the 20 elementary business requirements, engineering and construction organizations can establish practical, common sense quality management systems to ensure that each customer's requirements are met and that the organization's fundamental business processes are continually evaluated and improved.

# Chapter 3

## Pilot Program Approach

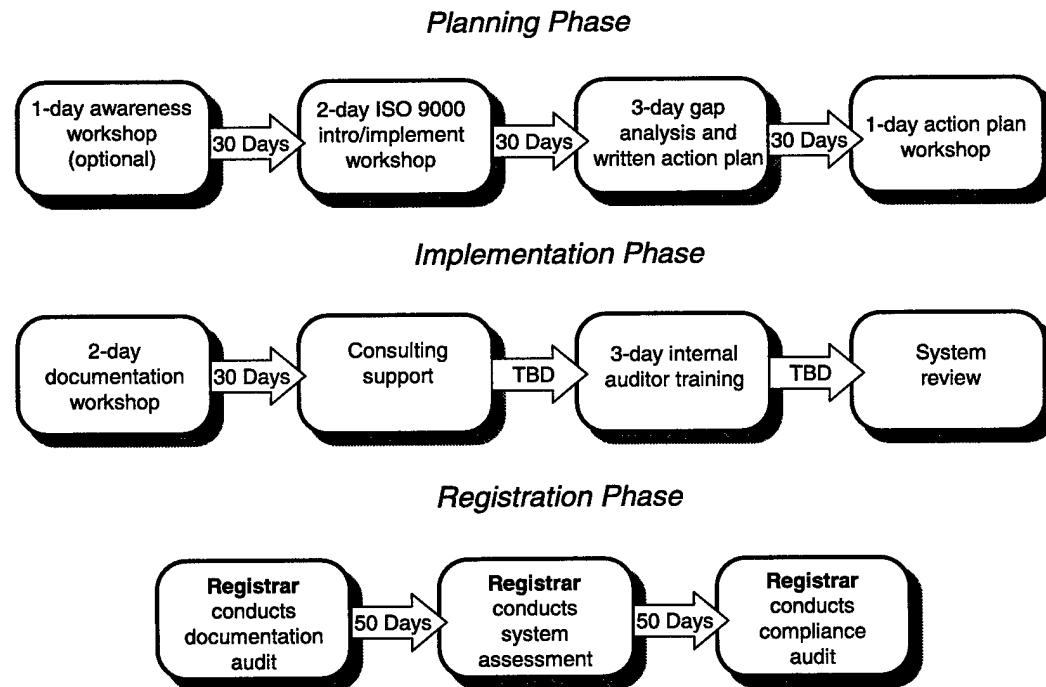
USACE began the ISO 9000 pilot program in the spring of 1995. Six divisions participated: Louisville District's Engineering Division and Construction Division, Savannah District's Engineering Division and Construction Division, Kansas City District's Engineering Division, and Portland District's Planning and Engineering Division. This chapter discusses the approach that the six Corps divisions used to become registered, as well as the approach that we used to identify the costs and benefits of ISO 9000 certification at those sites.

## CERTIFICATION APPROACH

### Strategy

The basic approach used by USACE in its ISO 9000 pilot program was the same methodology its consultants had used with private-sector corporate clients such as Ford Motor Company. The certification strategy included three phases: planning, implementation, and registration. Figure 3-1 portrays the strategy. The LMI team facilitated the planning and implementation phases; the registration phase is the responsibility of the registrar.

*Figure 3-1. ISO 9000 Implementation Strategy*



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## PLANNING PHASE

The planning phase has three basic modules: a 2-day introduction and implementation workshop, a 3-day gap analysis and action plan, and a 1-day action plan workshop. The 1-day awareness workshop is optional. The recommended elapsed time for this phase is 90 days but, during the pilot program, it took as few as 2 months and as long as 10 months to accomplish.

The awareness workshop was targeted to the management team. It was intended to be available only for those divisions that felt they needed to generate enthusiasm and support in the senior management ranks for implementing a system to improve quality. The objectives were to increase awareness of quality issues and discuss the importance and relevance of the ISO 9000 standard. The agenda for the workshop included an introduction to quality and quality management, discussions of why quality should be managed using ISO 9000 and why quality is important to USACE engineering and construction activities, an introduction to ISO 9000, and discussions of the link between Total Army Quality and ISO 9000 and how, together, they will enable USACE to satisfy its customers.

The ISO introduction and implementation workshop was attended by the ISO project steering team, the management representative, and the internal audit team (if it had been established). The objectives were to provide a general understanding of the ISO 9000 standards as they apply to USACE, develop and refine the implementation strategy for the division and reach agreement on the dates for completing activities, and begin addressing ISO 9000 requirements for management responsibility. The agenda for the workshop included the following topics: interpretation of ISO 9000 in USACE, implementation/registration process, management representative and steering team responsibilities, and awareness strategy. In addition, during the workshop, attendees began drafting the scope of registration and the quality policy and objectives for their division, along with an applicability matrix and high-level process flow charts.

The purpose of the gap analysis, which was performed by the LMI team, was to identify current quality system shortfalls and actions needed to bring the system into compliance with ISO 9000 requirements. LMI reviewed the existing quality systems in the context of the scope of registration agreed upon during the introduction and implementation workshop. The activity included an initial briefing, extensive interviews, and an exit briefing on the initial findings. The gap analysis typically took 3 days.

The results of the gap analysis were documented in a report and used to develop a 1-day action plan workshop. The workshop was attended by the steering team, management representative, and internal auditors (if they had been selected). The objectives of the workshop were to finalize planning activities—by presenting gap results, developing a clear understanding of what is needed to achieve

certification, and estimating the labor required—and to gain commitment to moving forward into the implementation phase.

## **IMPLEMENTATION PHASE**

The implementation phase has four modules: a 2-day procedures and documentation workshop, periodic consulting visits, a 3-day internal auditor training class, and a comprehensive system review just before beginning the registration phase. The total elapsed time for this phase was expected to be approximately 6 months, but the three divisions that had achieved certification when this report was written took 6 to 18 months.

The 2-day procedures and documentation workshop kicked off the implementation phase of the program for the pilot sites. The workshop was attended by the steering team, management representative, and quality action team members. Depending on how the division was going to execute the procedures review and documentation development, this workshop could be attended by quite large number of staff members, many of whom had not attended the previous workshops and were not oriented to the ISO 9000 standard. The objective of the workshop was to provide the people that were going to do the work with the training needed to independently develop procedures and documentation that would serve as the foundation for their quality system manual.

The consulting visits as conceived in the strategy were to occur once between the procedures and documentation workshop and the internal auditor training, then after the training and before the system review. The purpose of the consulting visits was to review the documentation in the context of the requirements of the standard. However, during the visits, the consultants provided advice on a variety of issues and, in fact, made several additional consulting visits.

The internal auditor workshop was intended to train the internal auditing team to conduct effective internal audits of the quality system. The 2-day workshop included an introduction to the standard and its interpretation; an explanation of auditing requirements, objectives, process, and intent; and discussions about collecting objective evidence, planning and conducting the audit and writing the report, and conducting practice audits.

## **REGISTRATION PHASE**

The registration phase generally includes a review of the documentation, a pre-assessment audit, and a compliance audit. The compliance audit is followed by periodic surveillance audits, typically at 6-month intervals. Although most registrars prefer the 6-month cycle, the surveillance audit interval is subject to negotiation and can stretch as long as 12-month intervals.

## Elapsed Times

The total time each of the divisions experienced in the framework of the strategy diagrammed in Figure 3-1 is displayed in Table 3-1. As the table shows, the times required to attain registration ranged from 22 months to 34 months (assuming Savannah Construction attains certification as planned). One site, Kansas City Engineering, has been operating under its ISO quality system since spring 1998 but has not yet set a schedule for the registration phase because of recent organizational and personnel changes. Another, Savannah Engineering, has not made a sustained management commitment to pursue ISO 9000 and is not working on developing its quality system at this time.

*Table 3-1. Elapsed Preparation Times*

District/division	Planning	Implementation	Registration	Total time
Louisville				
Engineering	3/95–10/95	11/95–4/96	March 1997	25 months
Construction	1/96–3/97	4/97–12/97	August 1998	32 months
Savannah				
Engineering	3/95–10/95	11/95–NA	Not planned	NA
Construction	2/96–3/96	3/96–9/97	Fall 1998 <sup>a</sup>	34 months <sup>a</sup>
Kansas City				
Engineering	5/95–1/96	3/96–11/96	Pending <sup>b</sup>	NA
Portland				
Planning and Engineering	11/95–1/96	3/96–11/96	August 1997	22 months

Note: NA = Not applicable.

<sup>a</sup> Planned.

<sup>b</sup> Pending = reconciling impact of organizational changes.

## Internal Costs

Headquarters paid for the consulting services for the pilot program. However, the divisions incurred indirect labor costs and incidental expenses for software or internal promotional literature; they also incurred the cost of the registrar's services. Table 3-3 shows the expenses reported by the divisions. The registrar fees shown in the table vary because of variations in the scope of services provided. Some registrar contracts covered one site, while others covered multiple sites, and some covered periodic surveillance audits at 12-month intervals, while others were at 6-month intervals. Finally, some contracts covered only 1 year's services while others were for 3 years.

*Table 3-2. Division Expenses for Pilot Program*

District/division	Labor and incidentals	Registrar
Louisville		
Engineering	\$190,000	\$25,000
Construction	\$125,000	\$60,000
Savannah		
Engineering	NA	NA
Construction	\$350,000	\$50,000 <sup>a</sup>
Kansas City		
Engineering	\$168,000	\$12,000 <sup>a</sup>
Portland		
Planning and Engineering	\$264,000	\$28,000

Note: NA = not applicable. Savannah did not complete preparation for certification.

<sup>a</sup> Estimated.

## Program Status

As of Sept. 1, 1998, three of six pilot sites had achieved ISO 9000 certification: Louisville Engineering (March 1997), Portland Planning and Engineering (August 1997), and Louisville Construction (August 1998). Savannah Construction and Kansas City Engineering have implemented their systems and have been successfully operating under them since October 1997; both are nearing the start of the registration process. Savannah Engineering has not had the management support to place a priority on implementing the standard.

Louisville Engineering has been through one surveillance audit, and Portland Planning and Engineering has been through two. Both are continuing to learn and benefit from their systems.

## ASSESSMENT APPROACH

Throughout the pilot program, LMI studied the experience of each of the participating divisions as well as experiences of other government agencies and the private sector for purposes of comparison. We participated in most of the training sessions, interviewed the divisions' management during different phases of the program, and conducted two important surveys to obtain information that would help USACE decide about the future of ISO 9000 certification in the Corps.

We sent the first survey to all individuals in the Louisville Engineering and Portland Planning and Engineering divisions shortly after they became registered as ISO compliant. Louisville and Portland received their certificates in March and

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August 1997, respectively. The survey asked managers, engineers, technicians, and administrative employees about the effectiveness of the training they had received and the benefits to their organizations of obtaining their ISO 9000 certificates. The survey was structured using Likert batteries in which respondents are able to rank answers on a scale from one to five. An open-ended comment response area was provided at the end of the survey to capture individual opinions on aspects of the certification process not covered elsewhere in the survey. We received responses from 218 people in these two engineering divisions. A copy of the survey questionnaire and an analysis of the results are in Appendixes B and C, respectively.

For the second survey, we sent questionnaires (in February 1998) to all six divisions involved in the ISO 9000 pilot program. The questionnaires contained 24 open-ended questions covering the entire process of preparing for ISO 9000 registration, from the organization phase to the final external audit for registration (if registration had been achieved by the survey date). Among other questions, we asked how long the process took, how much it cost, what problems were encountered, what the negative aspects were, what the positive benefits were, and how the management representative and internal auditors were selected. We also asked general questions about how the process was managed, what process was used for preparing and controlling documentation, how initial and follow-on training was done, and what changes were recommended for implementing the certification process. Finally, we asked for suggestions for districts considering pursuing ISO 9000 registration. The questions and the corresponding answers provided by each of the four divisions that responded are in Appendix D.

## Chapter 4

# Assessment of Pilot Program

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Our focus when assessing the ISO 9000 pilot program was on aspects that would help USACE decide whether the quality system should be implemented throughout the Corps. In this chapter, we present our general findings, then discuss specific lessons learned during the certification process. We then discuss the costs and benefits of implementing the ISO quality system at the six Corps sites.

### GENERAL FINDINGS AND OBSERVATIONS

From the results of our surveys, it is clear that ISO 9000 has improved organizational effectiveness. Pilot sites achieving certification indicated that the move to an ISO 9000 quality management system has had a demonstrably beneficial effect on the Corps of Engineers and would recommend ISO 9000 registration to other districts. These districts cited a variety of benefits, the most prominent being a divisionwide clarification of procedures and the genesis of an understandable, well-defined operating system.

Managers believe the ISO 9000 standards provide both a foundation for an effective quality management system and a basis for improving customer service. Staff communications have improved, better work products are being delivered, and "fire drills" are becoming less common. ISO 9000 imposes order and discipline on the system so that once a problem surfaces, management must address the issue and develop a solution that may include a change in procedures, additional training, or both.

The Corps goal is to provide quality engineering products and services to its consumers, and ISO 9000 has simply allowed all involved parties to become aware of how that goal is achieved. Internally, ISO 9000 registration has forced organizations to truly understand their operating system. Procedures are well documented and available for reference, duties and responsibilities are clearly assigned, and the elimination of unnecessary backtracking allows the maximization of division resources.

The centralizing tendencies of operating under an ISO 9000 system permit employees to more efficiently produce the quality service that is associated with USACE. Moreover, ISO 9000 meshes well with USACE's quality assurance process—Total Quality Management—and its historic philosophy of continuous improvement. ISO 9000 provides a foundation upon which TQM can have quantifiable results and excellent performance can be achieved, even attaining the Malcolm Baldrige performance level.

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ISO 9000 is beneficial for the Corps customer in that it requires a defined scope of work prior to the initiation of activity. The immediate result is fewer discrepancies between customer expectations and execution of contracted services by USACE, translating to the subsequent long-term benefit of customer satisfaction. While ISO 9000 registration is likely to extend a competitive edge to USACE now, it is also likely that registration will be an advantage well into the future.

## LESSONS LEARNED

Within the context that the program has been successful (three divisions have achieved certification and two more will do so shortly), the approach to ISO 9000 certification can be improved significantly. In particular, the time it takes for completing such an initiative can be dramatically reduced from that experienced by the pilot sites, with a corresponding reduction in expense.

The approach to certification used in the pilot program was defined in three phases: planning, implementation, and registration. The planning process, with its multiple workshops and gap analysis, and with breaks of 30 or more days between each event, was ineffective and typically took from 6 to 14 months. Only Portland conducted the planning phase in less than 6 months. Because of the amount of time for this phase, some divisions lost momentum. In addition, because of the disruptive nature of the various training events and the inconsistent mix of attendees, many participants in the pilot program complained that they had difficulty understanding what the intent and requirements of the standard are and how they applied to the Corps, as well as what tasks had to be done to prepare for certification. The use of training materials that were too generic and not focused on the Corps also contributed to the lack of understanding.

The implementation phase as presented was somewhat misnamed because it included analysis of the business processes and preparation of documentation, but did not focus on the important feature of operating under the quality management system. The organization must be able to prove to the registrar that it is using the system successfully. Without such proof, it is premature to begin working with the registrar to achieve certification to the standard.

The following are some specific findings particularly relevant to the implementation of ISO 9000 Corps-wide:

- ◆ Total and continuous management support is important to the successful development of an ISO 9000 management system.
- ◆ The undertaking to prepare an ISO-compliant management system should be planned and managed just like a high-priority project.

- ◆ Districts can successfully take different approaches to reviewing their existing business processes and developing their quality system documentation.
- ◆ The managers and other staff members that form the team doing the work should be identified and receive orientation and training early in the project planning and mobilization phase. Elementary ISO training is important to staff members at all levels of the work force.
- ◆ Auditors should be selected carefully because they play an important role in the initial success of the program.
- ◆ The total time and cost to attain ISO 9000 certification could be reduced.
- ◆ The ISO certification process does not require changes in the organizational structure.
- ◆ The ISO consultant should have knowledge of USACE engineering and construction activities.
- ◆ ISO 9000 and existing USACE quality requirements are compatible.
- ◆ Simultaneous implementation of an ISO quality management system for engineering and construction divisions in the same district should be tested.

Each of these findings is discussed in more detail in the following subsections.

## Management Support

Pilot organizations repeatedly emphasized that senior management commitment to the ISO quality management system is a must. This commitment must be communicated to supervisors and employees at all levels of the organization, especially through the allocation of the necessary resources. Combining ISO program responsibility with normal management responsibility proved effective in allocating resources and shifting the divisions' culture to the ISO management system. Divisions that did not align responsibility this way had more difficulty making progress.

Louisville Engineering was the first to achieve certification. That division's top management demonstrated its support for ISO 9000 by naming the division's assistant to the division chief as the management representative. That individual was able to write ISO goals into the annual business plan, allocate resources, set priorities, and integrate ISO concepts into the division's management practices early in the process. Successful efforts to sustain momentum included the use of frequent staff e-mails, discussion of issues and updates in documented procedures during weekly management and staff meetings, and provision of refresher courses

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as needed. These communication procedures appeared effective for building support and reminding staff members of their vested interest in achieving and maintaining ISO certification.

## Level of Importance

The effort it takes to prepare an ISO-compliant management system is significant. The greater the effort put into the process, the greater the benefit to the organization is. The best results occur when the undertaking is treated like a high-priority project with thoughtful planning, scheduling, and execution.

## Documentation

In general, the pilot organizations established multiple teams to prepare the documentation necessary to meet ISO registration requirements. Both the number of teams and the team compositions varied. Team leaders were usually branch or section supervisors, and team members were selected on the basis of their subject knowledge. Pilot organizations used their LANs or intranets to varying degrees in the development, control, and dissemination of ISO documentation. The most advanced division used totally electronic means for document dissemination and control.

The management representative, ISO coordinator, and consultant played key roles in the preparation, review, editing, revision, and publication of the work instructions and materials in the quality manual. Process review and documentation are critical steps on the path to ISO certification and should not be cut short to save time or money.

As noted by some of the pilot sites, the procedure review/documentation phase would have been shortened considerably had a template or "model" quality manual been available for reference use. The Portland Planning and Engineering Division's ability to use the manuals developed by the Louisville District and U.S. Coast Guard as templates saved an estimated \$8,000 to \$10,000. Since this phase was the most time-consuming, and since the quality manuals from the pilot sites are now available for reference, this phase of the registration process can likely be expedited for new sites that want to attain ISO 9000 certification and thus save money. Districts considering ISO 9000 registration should anticipate that their start-up costs likely will be lower than those for the pilot organizations.

## ISO Training

The steering committee and execution team that will evaluate the existing workflow processes and prepare the quality system manual should receive their initial ISO 9000 orientation and documentation training at the same time and early in the

project planning process. The pilot sites had different training for different groups at different times and experienced an inefficient and arguably ineffective process.

Also, elementary ISO training was important to staff members at all levels of the work force because they had little or no previous knowledge of the elements of the ISO standards and their purposes. Normal employee resistance to change means awareness and orientation training is extremely important. Eventually, supervisors and management representatives provided orientation and follow-on training to the work force on numerous occasions. The LAN and intranet have been used to augment and reinforce this training. ISO 9000 orientation has been incorporated into new employee indoctrination. Additional or refresher training is scheduled as necessary.

## Selection of Internal Auditors

Some pilot organizations took advantage of the existing quality assurance organizations in the district when selecting their internal auditors. Louisville Construction used its branch that was performing quality assurance visits to field offices for its internal auditors. Louisville Engineering uses the district's Internal Review Office as internal auditors and has trained its staff to perform the function as well. Savannah Construction and Portland selected auditors from sections within their respective divisions. Auditing is an ongoing (not constant) responsibility and requires individuals not only with excellent knowledge of the ISO 9000 standard but also with the right attitude and interpersonal skills. Auditors should be selected very carefully; they play an important role in the initial success of the program.

While internal auditors are professionally trained, some felt this training was too general and often missed the mark. Internal auditors gain the most knowledge and best experience by actually conducting audits. Auditors selected from the Internal Review Office to be ISO internal auditors naturally tend to adapt more easily to ISO audit requirements.

This training should be provided after the ISO 9000-compliant quality management system is implemented because the trainees should begin immediately to audit the system. In one instance, providing the training too soon required that the auditors be retrained when their services were needed. The individuals selected for this assignment need to fit specific skill requirements and be able to perform audits periodically as a routine part of their normal workload.

The auditing function is important to the very purpose of the standard. The entire system must be audited by the internal auditors prior to certification, and there must be documented evidence that the function is performing properly. Continuous improvement is an attribute of the ISO 9000 standard that distinguishes it from all other quality programs and is indeed fundamental to its success.

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## Time and Cost to Attain ISO 9000 Certification

In 1995 when the pilot program was initiated, it was generally thought that registration could be achieved in 12 to 14 months. However, for the four pilot organizations reporting, the time to acquire ISO certification ranged from 15 to 33 months, with an average of 23 months (see Table 3-1). The dramatic difference between expectation and reality can be explained principally by the fact that this had not been done before with the Corps, so a lot of new ground needed to be covered. In addition, the training was not tailored to meet USACE needs. However, the amount of preparation time also contributed substantially to the total time required. Respondents to our February 1998 questionnaire indicated that they spent from 6 to 14 months at the beginning trying to figure out what to do. A reduction to 30 days for developing the management plan, conducting initial training, and getting started on process reviews is entirely achievable, saving both time and money. By dramatically reducing the schedule for initial organization work, USACE organizations can realistically expect to achieve registration in 12 to 18 months if they do not experience disruptions because of urgent or emergency work.<sup>1</sup> A more compressed schedule also would make it easier to keep the work force highly focused on organizing and implementing the ISO 9000 standards. Finally, by expediting the process, costs could be reduced. Costs for the entire registration process, including the preparation of documentation, training of the internal auditors and the work force, and consultant support averaged \$250,000 to \$300,000 for the pilot sites.

## Effect on Organizational Structure

While the organizations undergoing the ISO certification process experienced a reduction in the number of full-time equivalent personnel (FTEs), their basic structure did not change. Implementation of ISO standards and the certification process did not cause the FTE reductions nor are any major reorganizations considered as a result of the ISO 9000 program. (Louisville Engineering moved the quality assurance manager from the Engineering Management Branch to report directly to the assistant chief.)

## ISO Consultant Requirements

The USACE pilot organizations relied heavily on ISO consultants during the certification process. However, the consultants were unfamiliar with engineering and construction activities. The respondent organizations felt that the value of the ISO consultants would be enhanced if they understood how the standards apply to the USACE design and construction business. Since the ISO consultants supporting their ISO 9000 program had limited knowledge of these Corps activities, the gap analysis report and associated briefing were not as effective as they could have

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<sup>1</sup> The estimated 12-to 18-month time frame assumes 6 to 12 months for system preparation and 6 months to implement and operate the quality management system.

been. The consultants did not address the intent of the standards' elements and their relationship to Corps business.

Not only would having consultants who are familiar with engineering and construction activities be beneficial to the Corps, but using the same consultants for each new district seeking ISO 9000 registration also would be beneficial. The consultants could share the experiences of the districts that have already attained registration.

## ISO 9000 and Existing USACE Quality Requirements

Concern that ISO 9000 requirements might be incompatible with existing USACE quality requirements—such as the quality assurance role of the major subordinate commands (MSCs)—was largely unfounded. While nuances in the terminology exist, attention to detail on the part of employees involved in the documentation of procedures appears sufficient to overcome this problem. It might be useful, however, to produce a glossary of compatible terminology based on the experience of participating districts.

## Simultaneous Registration of Multiple District Organizations

The pilot sites were intentionally planned to pursue ISO 9000 certification one division at a time. The thinking was to test the applicability of the ISO 9000 management system within the purview of a single senior-level manager (one division) rather than undertake a broader and more complex assignment dealing with multiple managers (stovepipes).

If multiple organizations within a district were to undergo the ISO registration process at the same time, the district engineer would have to make an ongoing commitment of resources and support. The management representative would have to be selected from within the executive office for the successful registration of more than one division under one certificate. One advantage of multiple certification cited was that this approach would assist in the breakdown of organizational stovepipes. These stovepipes have historically impeded coordination among divisions and taken a toll on organizational efficiencies and customer support. Another advantage is cost. Leading two or more district organizations through the process simultaneously, rather than sequentially, would produce efficiencies throughout the planning, organizing, and implementation phases. Could a district do this without negatively impacting ongoing core activities? This is a key question to consider before embarking on such an approach. The pilot sites generally agreed that the least disruptive approach would be to continue to proceed one division at a time.

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## COSTS AND BENEFITS

The issue of costs and benefits is of interest to all parties. Unfortunately, no quantifiable data are available to analyze costs and benefits in a rigorous financial framework. We do, however, have strong evidence that a significantly favorable cost-benefit exists. All pilot sites stated that operating under the ISO 9000 quality management system has had a demonstrably beneficial effect on the Corps and that they would recommend ISO 9000 registration to other districts. The districts that participated in the pilot program cited a variety of benefits, the most prominent being a divisionwide clarification of procedures and the genesis of an understandable, well-defined operating system.

Participating organizations have not operated under the ISO 9000 standards long enough to identify and quantify tangible benefits and savings. However, they believe that going through the ISO registration process has increased their understanding of their business processes and has heightened their awareness of quality and its importance to meeting customer expectations. They also point to the significant cost savings and other benefits they have achieved by using the intranet to make all technical references readily available, minimizing the need for hard copies, and ensuring the use of the most current documents. Putting all reference regulations, codes, and standards on the intranet is a significant cost savings, particularly for the construction divisions, and has dramatically improved their ability to quickly access technical information.

Participants have pointed out that the costs they incurred on ISO registration would have been incurred for something similar anyway; each division has a senior management staff that spends a considerable amount of time on quality policies, procedures, and issues. Deciding to spend their funds specifically on becoming compliant with ISO 9000 was just a matter of setting priorities on how to spend the discretionary portion of the departmental overhead budget.

To provide a glimpse of the type of quantifiable data that may become available concerning the costs and benefits of ISO 9000, we will use the experience of Louisville Engineering. Over several quarters, that division reduced its projected cost growth (due to errors, changes, omissions, etc.) by 50 percent. Although many variables likely contributed to the reduction, certainly some of this impressive reduction can be attributed to the division's successful implementation of the ISO 9000 quality system.

The potential impact of implementing an ISO quality management system throughout the Corps can be illustrated by the following example:

Assume the Corps' construction portfolio of \$2,160 million includes a total cost growth of 6.15 percent, or \$133 million. If, by operating under an ISO quality management system, the Corps could reduce the cost growth to 3 percent, it could save an estimated \$66 million per year.

In addition to the information gained from surveying the experience of the pilot sites, we have looked at the available literature to learn from the private-sector experience with ISO 9000. In 1996, Dun and Bradstreet conducted a nationwide survey of organizations registered to ISO 9000; 1,880 organizations responded. The results are summarized in Table 4-1.

*Table 4-1. Responses to Dun and Bradstreet Survey*

Factor	Response
Higher perceived quality	83%
Competitive advantage	70%
Reduced customer quality audits	56%
Improved customer demand	29%
Increased market share	18%
Quicker delivery of products	6%
Better documentation as an internal benefit	88%
Greater quality awareness by employees	83%
Enhanced internal communications	53%
Increased operational efficiency	40%
Main driver for seeking ISO 9000 certification—quality benefits	77%
Main driver for seeking ISO 9000 certification—market advantage	73%
Main driver for seeking ISO 9000 certification—customer expectation	68%
Average total cost of registration	\$187,000
Average total cost of registration: 1993	\$245,000

Source: Irwin Professional Publishing and Dun and Bradstreet Information Services, *ISO 9000 Survey: Comprehensive Data and Analysis of U.S. Registered Companies*, 1996.

Note: Percentages are rounded.

The bottom line on costs versus benefits is that, even in the absence of reams of quantifiable data, it is abundantly clear that USACE will benefit significantly as more and more of its organizations receive their ISO 9000 certificates of registration.

## Chapter 5

# Conclusions and Recommendations

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The organizations participating in the pilot program are enthusiastic about both the experience and the results of the ISO 9000 certification process. From their comments and our observations, we conclude that the benefits of ISO certification outweigh the costs in time and money.

ISO 9000 registration undoubtedly offers valuable benefits to the Corps. Pilot organizations report that their postregistration operations are streamlined, more efficient, and consistent with the operation of an engineering and construction organization. The rigor of maintaining registration is of value as well; it forces organizational self-examination in preparation for external audits. Registration is just the initial step; the positive effects of operating under an ISO 9000 quality system can be expected to continue indefinitely, not just immediately after implementation.

Less tangible, but equally worthy, is the effect of ISO 9000 on morale. ISO 9000 represents a positive cultural change. At all pilot sites it has led to better internal communication, increased teamwork, improved the ability of individuals to see the big picture, reduced the time required to deal with routine procedures, clarified responsibilities, and reduced errors and rework. The benefits of operating under the ISO quality management system are undeniable.

Some divisions viewed the cost of the ISO 9000 registration process as too high. However, with the benefits of improved efficiency and effectiveness, we believe these costs are reasonable given anticipated time and labor savings. In any case, some management time must be spent in the quality policies and procedures arena, so some of the cost incurred would have been necessary even without ISO 9000 implementation. In short, Corps-wide ISO 9000 registration appears to be a worthy strategy for ensuring that USACE consistently delivers quality products and services.

To facilitate the implementation of ISO 9000 throughout the Corps, we recommend that USACE take the following steps:

- ◆ *Adopt ISO 9000 as the Corps quality management standard.* Revise ER 1110-1-12 accordingly to direct the application of the standard and maintenance of registration.
- ◆ *Direct all engineering and construction divisions to achieve and maintain registration to the ISO 9000 standard.* The pilot sites clearly benefited

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from preparing for, achieving, and maintaining their registration to the ISO quality management system.

- ◆ *Develop customized training materials.* Each division spent a great deal of time organizing its efforts before it began defining its processes and documenting them. The organization phase could be streamlined through the creation of a customized training curriculum made available to all divisions. It would be relatively easy to produce a Corps-specific set of guidelines and implementation recommendations. Once these guidelines and recommendations were in place, USACE districts could expedite achieving ISO 9000 registration.
- ◆ *Create a model policy and procedures manual.* To decrease costs associated with preparing the policy and procedures manual, we recommend that the quality manuals created by the pilot sites be used as the basis for creating a model policy and procedures manual that could be applied in a generalized fashion to all USACE ISO 9000 registration efforts and fully utilize knowledge gained from the ISO 9000 implementation process. Having a model manual would make it significantly easier for districts to get started. However, the model manual would not be a substitute for the hard work of each organization examining its business processes. Private-sector companies with multiple sites have used this approach successfully.
- ◆ *Form a headquarters working group.* The ISO 9000 management system offers many opportunities to improve coordination, not only within the districts but also at all levels of the Corps. We recommend forming an ISO 9000 working group at headquarters to be the nerve center and clearinghouse for ISO experience within the Corps. The working group should develop a detailed implementation strategy; coordinate ongoing program activities; compile data on experience, successful strategies, and lessons learned; communicate with USACE senior management; and raise issues for management resolution. The group would function as a focal point for continuous program improvement.
- ◆ *Develop annual experience evaluation metrics.* A benefit of an ISO 9000 operating system is its ready translation to usage as an evaluation metric. ISO 9000 can serve as a basis on which to judge performance, a usage that fits well with USACE's vision of continuous improvement. We recommend development of performance metrics and continuous improvement measures to track progress at each division that achieves certification. For example, targets for measuring the ongoing system suitability and effectiveness should be developed. Internal measures could include aspects related to project delivery, system audits, reviews, corrective and preventive actions, and predelivery design changes. External measures might cover customer reviews, cost and schedule performance, customer feedback, and postdelivery modifications.

- ◆ *Procure a single registrar.* We recommend that headquarters acquire and make available a task order contract for registrar services. This approach would save the districts both the time and cost of procuring those services, and the total cost to the Corps of ordering registrar services off a master contract would be less overall than purchasing them individually. Furthermore, since the registrar plays such an important educational role in the process, using the services of one organization familiar with USACE and its operations would be advantageous.
- ◆ *Begin concurrently implementing ISO quality management systems in multiple divisions within a district.* Implementing an ISO quality management system in multiple district divisions (programs, planning, engineering, construction, and contracts) at the same time appears to be a feasible and attractive approach that the Corps should test. Although defining interfaces among divisions could be time-consuming and potentially difficult, the existence of USACE-specific training materials and a model quality manual would ease the process considerably. Implementation would likely become the only area requiring a serious time commitment on the part of individual districts and their respective divisions.
- ◆ *Test application of ISO 9000 beyond the district level.* Headquarters and the major subordinate commands could benefit from ISO 9000 registration; the ISO quality management system should be applied throughout the Corps, not just at the district level. Should the Corps decide to implement this recommendation, it would need to evaluate existing directives, guidance, management protocols, and regulations in the context of an effective Corps-wide ISO 9000 program. Audit requirements for the MSCs and districts would also have to be reconsidered. In the meantime, USACE headquarters should evaluate its directives and guidance documents in terms of their effects on individual units that achieve ISO certification.
- ◆ *Train major subordinate command quality assurance people as internal auditors.* MSC quality assurance people should be trained as ISO-certified internal auditors. Under their new role as “business centers,” the MSCs should also be certified to ISO 9000 and can use the process of preparing for registration to work through and define their new business processes. The quality assurance people could also play a productive role in assisting districts with the registration.
- ◆ *Apply electronic and Web technology for document control.* Key to the success of the engineering and construction divisions is the use of electronic document control strategies and the use of the Corps intranet to give all offices access to reference documents. The work that has gone into this in Louisville and Savannah should be utilized to develop a generic document control system. Such a tool would save time and money for any USACE organization pursuing ISO registration.

# Appendix A

## Guidelines for USACE Conformance with ISO 9000 Standards

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### INTRODUCTION

This appendix provides USACE an interpretation of the ISO 9000 quality system standards as they apply specifically to managing USACE engineering and design (E&D) and construction projects, including civil works; military construction; or hazardous, toxic, and radioactive waste projects. It also contains guidance for complying with the requirements of the standards in terms that should be familiar to typical USACE engineering and construction personnel. The interpretation and guidance in this appendix should not be applied to other USACE district functions such as project management, contracting, and resource management.

This appendix should be read in conjunction with the ISO 9000 standards (ISO 9001 for engineering activities and ISO 9002 for construction activities).<sup>1</sup> The requirements in the ISO standards take precedence over the interpretation provided in this document, and deviations from the requirements specified in the ISO standards must be sufficiently addressed in the organization's quality policy documentation.

### REFERENCES

The following publications describe the ISO 9000 quality management system:

- ◆ ISO 9001, Quality Systems—Model for Quality Assurance in Design, Development, Production, Installation, and Servicing
- ◆ ISO 9002, Quality Systems—Model for Quality Assurance in Production, Installation, and Servicing
- ◆ ISO 9003, Quality Systems—Model for Quality Assurance in Final Inspection and Test
- ◆ ISO 9004, Parts 1–4, Quality Management and Quality System Elements (general guidelines and guidelines for services, processed materials, and quality improvement)

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<sup>1</sup> ISO 9000 standards are reproduced in the United States under the American National Standards Institute and the American Society of Quality Control Q9000 series.

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- ◆ ISO 8402, Quality Management and Quality Assurance—Vocabulary
  - ◆ ISO Guide 34, Quality System Guidelines for the Production of Reference Materials
  - ◆ ISO 9000, Parts 1–4, Quality Management and Quality Assurance Standards (guidelines for selection, use, and application of ISO 9001, ISO 9002, and ISO 9003)
  - ◆ ISO 10005, Quality Management—Guidelines for Quality Plans
  - ◆ ISO 10006, Quality Management—Guidelines to Quality in Project Management
  - ◆ ISO 10007, Quality Management—Guidelines for Configuration Management
  - ◆ ISO 10011, Parts 1–3, Guidelines for Auditing Quality Systems (auditing, qualification criteria for auditors, and management of audit programs)
  - ◆ ISO 10012, Parts 1–2, Quality Assurance Requirements for Measuring Equipment (metrological confirmation system and guidelines for controlling measurement processes)
  - ◆ ISO 10013, Guidelines for Developing Quality Manuals

Relevant USACE publications about engineering and construction management include the following:

- ◆ Army Regulation 5-1, Army Management Philosophy
- ◆ Engineering Publication (EP) 415-1-260, Resident Engineer Management Guide
- ◆ EP 415-1-266, Resident Engineer Management guide for Hazardous, Toxic, and Radioactive Waste Projects
- ◆ Engineering Regulation (ER) 1-1-11, Administration—Progress, Schedules, and Network Analysis Systems
- ◆ ER 25-345-1, System Operation and Maintenance Documentation
- ◆ ER 415-1-10, Contractor Submittal Procedures
- ◆ ER 415-1-11, Biddability, Constructibility, Operability, and Environmental
- ◆ ER 415-1-13, Design and Construction Evaluation (DCE)

- ◆ ER 415-3-11, Engineering and Design Post-Completion Inspection Feedback
- ◆ ER 415-7-1, Contractor Performance Evaluations
- ◆ ER 715-1-8, Architect-Engineer Contract Administration Support System
- ◆ ER 715-1-10, Architect Engineers Responsibility Management Program
- ◆ ER 715-1-15, Time Standards for the Architect Engineer Acquisition Process
- ◆ ER 1110-1-12, Quality Management
- ◆ ER 1110-1-263, Chemical Quality Management for Hazardous Waste Remedial Activities
- ◆ ER 1110-1-1150, Engineering and Design for Civil Works Projects
- ◆ ER 1110-1-1200, Drawings and Specifications
- ◆ ER 1110-345-100, Design Policy for Military Construction
- ◆ ER 1110-345-700, Design Analysis
- ◆ ER 1110-345-710, Drawings
- ◆ ER 1110-345-720, Construction Specifications
- ◆ ER 1180-1-6, Contracts—Construction Quality Management.

## DEFINITIONS

The ISO 9000 standards carry a specific set of definitions consistently applied throughout the series of contractual and guidance documents. Those definitions, further defined as they specifically apply to USACE engineering and construction organizations, are as follows:

- ◆ Supplier—the USACE engineering or construction division (or other organizational activity with similar responsibilities).
- ◆ Product—the result of activities or processes. The ISO 9000 standards note that a product may be a service rendered, hardware, processed materials, software, or any combination thereof, and it may be tangible or intangible (e.g., knowledge or concepts). For USACE engineering organizations, the product can be the engineering plans and specifications, engineering studies, and/or services provided that relate to the

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management and support of any E&D project throughout its life cycle (project initiation and planning, design development, design support and servicing). For USACE construction activities, the product is a service—management of a construction project throughout its life cycle (scheduling, quality assurance, cost control, claims analysis).

- ◆ Customer—anyone or any organization that receives a product from a USACE engineering or construction division. Customers can be either internal or external to the USACE district. Internal customers may include the district's project management, contracting, construction, or operations activities, while external customers may include Army installations, Air Force installations, or other federal or state governmental agencies.
- ◆ Contract—any contract instrument or medium (written or oral) used to establish agreed-upon requirements between the USACE supplier and the customer. The contract may be a memorandum of agreement (MOA), memorandum of understanding (MOU), delivery order, DD Form 1391, work order, action required under the project management plan, or traditional contract vehicle.
- ◆ Tender—offer made by the engineering or construction organization in response to any invitation by a customer for the provision of a product.
- ◆ Prime contractor—any firm hired by USACE to execute a construction contract (referred to as subcontractor in the ISO standard).
- ◆ Subcontractor—any firm hired by the USACE district to provide A-E services, laboratory services, or construction services.
- ◆ Government-furnished equipment (GFE)—all materials either purchased by the USACE district's contracting activity or by the customer for inclusion in the contracted facility. Examples include fixtures, furnishings, and specialized equipment that a customer may provide under another contract that will be delivered to the site for placement or installation in the contracted facility.

## QUALITY SYSTEM REQUIREMENTS

The following subsections provide the requirements and guidance for the 20 elements that a USACE engineering division must address to comply with ISO 9001. The numbering structure coincides exactly with that used in the ISO 9001 standard. A USACE construction division must address all of the same elements, with one exception—4.4, Design Control.

## 4.1 Management Responsibility

### 4.1.1 QUALITY POLICY

#### Requirement

To meet the requirements of this element, senior management (chief, deputy, or committee of branch chiefs) must make sure that

- ◆ a quality policy and quality objectives are well defined, approved, audit-able, measurable, and sufficiently documented;
- ◆ the policy cites commitment to developing the highest quality products, meeting customers' expectations for quality products and services, and satisfying personnel needs;
- ◆ everyone in the organization understands, embraces, and practices what is represented by the policy; and
- ◆ the quality policy is consistent with USACE and district quality directives, engineering and construction policies, organizational quality goals, and the expectations of customers.

Note: Quality policy is defined by ISO 8402 as “the overall intentions and direction of an organization with regard to quality, as formally expressed by top management.” ISO 9004 defines quality management as “that aspect of the overall management function which determines and implements quality policy.” The element emphasizes that the responsibility for quality belongs at the highest level of management in an organization.

#### Guidance

The quality policy and objectives developed and promulgated by the engineering or construction division should be consistent with any policies, goals, and mission statements already in place in the district. Moreover, they should be

- ◆ relevant, measurable, and ambitious, yet achievable, and
- ◆ easy for everyone in the division to understand.

The quality policy and objectives should be specific. It may not be enough simply to say that the division will reduce design costs, but rather that they will be reduced, for example, by at least 10 percent. The following are examples of quality objectives that are relevant, measurable, and achievable:

- ◆ Design projects will be completed on time 95 percent of the time (on time means ready to advertise within 1 month of original scheduled date).

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- ◆ Construction projects will be completed within budget 95 percent of the time (within budget means not exceeding the programmed amount by 10 percent).
  - ◆ Controlled design cost growth will not exceed 2 percent.
  - ◆ All contract actions will be closed out within 6 months of owner occupancy.

In addition, while not required specifically by the standard, the division's executive management should do the following:

- ◆ Define its key elements of quality, such as fitness for use, responsiveness to customers, effective cost control, and compliance with the organization's internal policy and regulations, guide specifications, and relevant codes.
- ◆ Consider the ramifications and costs if its quality objectives are not met.
- ◆ Provide sufficient resources to develop the organization's policies and objectives so that they are meaningful, measurable, achievable, and understandable to everyone in the engineering organization (it is good practice to have the staff participate in developing them).
- ◆ Determine the required skill, experience, and training to achieve those goals.
- ◆ Ensure that the policy and objectives are written simply and clearly.

#### 4.1.2 ORGANIZATION

##### 4.1.2.1 Responsibility and Authority

###### Requirement

The engineering or construction division must define the responsibilities, authorities, and interrelationships of everyone managing or otherwise affecting the quality of its products and services. The documentation must include organization charts along with functional descriptions for branches, sections, and field activities under its authority. In addition, the documentation must refer specifically to the personnel who review and verify products as well as correct or prevent non-conformities occurring in the product, system procedures, or quality system.

## Guidance

Members at all levels of the division should

- ◆ understand their job functions and responsibilities,
- ◆ understand for what responsibilities and actions they will be held accountable,
- ◆ be aware of their impact on product and service quality,
- ◆ have adequate authority to carry out their responsibilities in relation to quality, and
- ◆ accept responsibility for achieving quality objectives.

### 4.1.2.2 Resources

#### Requirement

The division's senior management must make sure that sufficient resources are available for quality control and quality assurance activities on every in-house project so that completed products conform to stated requirements. In addition, personnel assigned to each project must be adequately trained and possess the experience and skills to successfully carry out their job assignments (on-the-job training is permissible). See 4.18, Training. Senior management also must make sure that adequate resources are available for

- ◆ inspection and verification of work performed by contractors, subcontractors, or engineering laboratories;
- ◆ review and approval of quality control plans submitted by contractors;
- ◆ in-process reviews and verification of contractor quality control plans; and
- ◆ internal quality system audits.

## Guidance

Effective verification of the products requires cooperation and objectivity among everyone involved. Adequate resources can involve the following:

- ◆ Awareness of the ISO standards and the organization's quality system
- ◆ Adequate training to perform the assigned duties
- ◆ Realistic quality assurance plans that allow ample resources for project scope development as well as design reviews and verification; biddability,

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constructibility, operability, and environmental (BCOE) reviews; supervision; and required engineering tests

- ◆ Adequate and proper equipment (e.g., computers, CD-ROM, computer-aided design and drafting workstations), software, and other resources to perform any quality system assignment.

Frequently, training budgets are set at the USACE district level and are beyond the control of engineering or construction management. In such cases, management should demonstrate that training requirements are identified and priorities established and that the high priorities are funded. Also, management can demonstrate a commitment to training if it redirects engineering or construction division funds to meet those training priorities.

#### 4.1.2.3 Management Representative Requirement

##### Requirement

The division's senior management must appoint a management representative who has the responsibility and authority for establishing and maintaining the quality system and for reporting to senior management on that system for reviews on system performance and opportunities for improvement. The appointed management representative must be a member of the management team, must be officially recognized, and must be identified in the quality manual or similar documentation.

##### Guidance

Anyone in the division could be selected as the management representative—the chief, the deputy, any one of the branch chiefs, or any other individual who is given the required organizational authority and line of control to the chief. The management representative should also have representation at any field activity by direct line of authority or through the appointment of agents at each field activity. A management representative selected from the division's management team will already have the needed authority to carry out the responsibilities associated with the position. That person should also possess the following qualifications:

- ◆ Be knowledgeable about traditional quality assurance techniques
- ◆ Thoroughly understand the ISO 9000 quality system standards
- ◆ Be committed to the importance of ISO 9000 to the engineering organization
- ◆ Be well respected within the organization
- ◆ Have excellent communication skills.

If the person selected to be the management representative does not already have the required quality system knowledge, training will be necessary.

The management representative may have other responsibilities in addition to quality system oversight, but those other duties should pose no conflict of interest with the duties associated with quality system oversight. Moreover, the person's role as management representative should be at least as important as those other duties.

#### **4.1.3 MANAGEMENT REVIEW**

##### **Requirement**

At defined and regular intervals, the division's senior managers must evaluate the existing quality system to ensure that it continues to be suitable and effective and to resolve any outstanding issues relating to the quality system and stated quality policy, goals, and objectives. Meeting minutes and actions taken must be recorded and maintained.

##### **Guidance**

The frequency of management reviews is not specified in the standard and will depend on local circumstances. Typically, however, auditors expect to see records of progress since the last audit. Since audits occur at least annually (for any particular element), it is widely held that management reviews should be scheduled at least as often as the registrar's ongoing annual or biannual assessments. In terms of follow-up, problems should be documented, analyzed, and resolved in a timely manner. The quality system reviews should address the following questions:

- ◆ Is the quality system (still) working effectively?
- ◆ Is the organization achieving its measurable objectives and stated quality policy (see 4.1.1, Quality Policy)?
- ◆ Are documented procedures current and consistent with the way they are applied by staff?

While the scope of the review rests with the division's senior managers, management should review at least the following elements:

- ◆ Results of internal quality system audits (see 4.17, Internal Quality Audits)
- ◆ Summaries of system nonconformities and deficiencies and of corrective and preventive actions taken (see 4.14, Corrective and Preventive Action)
- ◆ Effectiveness of current organizational structure and current quality infrastructure

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- ◆ Progress toward implementation of the quality system and attainment of established quality goals and objectives (revision of policies, goals, and objectives may be necessary)
  - ◆ Current and required training and effectiveness of training taken
  - ◆ Perceived and achieved quality of the products or services
  - ◆ Information from customer feedback.

#### **GUIDELINES FOR CONFORMITY**

- Within the organization, has senior management established and approved quality policies and objectives, and are they well written?
- Does the quality policy address organizational goals and customer expectations?
- Are procedures in place to ensure that the policy and objectives are effectively communicated and understood by everyone in the organization?
- Has management's commitment to those policies and objectives been defined?
- Has a management representative within the organization been charged with overall responsibility for ensuring that all ISO 9000 requirements are implemented and maintained? And is that appointment recorded in the quality manual?
- Does the management representative have sufficient authority to develop, monitor, and change the quality system? Is that person a member of the management team?
- Is the quality system periodically reviewed by an executive committee to ensure that it is still suitable and effective, and are records of those reviews maintained?
- Are personnel adequately trained in the organization's quality management programs?
- Has the organization defined the responsibilities and authorities of people involved in design review and internal quality audits as well as people involved in the identification and recording of any quality system or product problems?

- Are organization charts and functional statements documented, and do they define the authority and responsibility to deal with design process and quality system problems?

## 4.2 Quality System

### 4.2.1 GENERAL

#### Requirement

The division must establish, document, and maintain a quality system aimed at conforming to its customers' specified requirements and at achieving customer satisfaction. That documented quality system must include a quality manual (see guidance below) that provides the organization's policy for each of the relevant elements of the ISO quality management system, as well as Army, USACE, district, and engineering or construction policies with respect to those ISO elements. The quality manual must also reference quality system procedures and outline the structure of the quality system. Typically, that structure includes the quality manual; quality assurance plans; quality system procedures; work instructions; other required quality system documentation; and relevant federal legislation, Army and engineering regulations, technical manuals, and guide specifications.

Note: The division must document all local policies and practices that deviate from Army and USACE regulations.

#### Guidance

The quality system applies to all activities related to the delivery of a quality product. These activities can range from initial project development through design and may continue through construction of the project if specified in the contract.

The documented quality system typically has a tiered structure, with each tier becoming increasingly detailed. At the top tier, the quality manual should explain the division's policy toward each element of the ISO standard and reference the required procedures. At the second tier, documented quality system procedures should discuss the who, what, when, and where for each applicable element and reference appropriate work instructions; that documentation should be short and easily understood, and the procedures should be illustrated through the use of flow charts. The third tier defines the work instructions—the details about how to meet the quality system requirements. Quality system records or proof of compliance form the fourth tier.

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ISO 9004 stresses that the goal of the documented quality system is to provide confidence that

- ◆ the system is understood by everyone in the organization and is carried out effectively,
- ◆ the product satisfies customer and industry requirements and customer expectations,
- ◆ the needs of both society and the environment have been addressed, and
- ◆ the emphasis is on problem prevention rather than detection and correction after a problem has occurred.

The quality manual may include the following elements:

- ◆ Signature of the division chief (or designee)
- ◆ Name and location of the district and division
- ◆ Organization's quality policy, goals, and measurable objectives
- ◆ Current organization charts and functional statements
- ◆ Designated quality responsibilities and name of the management representative
- ◆ Accepted management review system
- ◆ Approved methods for revising and updating the manual
- ◆ Complete coverage of all quality system elements
- ◆ List of quality system procedures.

#### 4.2.2 QUALITY SYSTEM PROCEDURES

##### Requirement

Documented quality system procedures that address the relevant ISO 9000 requirements and the division's quality policy, goals, and objectives must be effectively implemented.

##### Guidance

Above all else, the documentation of the quality system procedures needs to be kept simple; two to four pages per procedure should be sufficient under most conditions. The division may select whatever format it wants for its procedures: flow

or process charts, models, narrative, or a combination of formats. The level of detail in the documented procedures should be inverse to the level of training, experience, and qualifications of the division's staff. In other words, relatively little documentation is required when the level of education, experience, and qualifications of the staff is relatively high. Conversely, for a staff with less education, experience, and qualifications, the processes and procedures should be documented in greater detail.

#### **4.2.3 QUALITY PLANING**

##### **Requirement**

As appropriate, the division must develop an overall organizational quality management plan that shows how it will consistently deliver quality products and meet its stated quality policy and objectives. It must also develop an effective quality assurance plan for each project. The plan must show how the technical, schedule, industry, and cost requirements for the project will be met. Quality plans must be developed in accordance with USACE regulations, division policy, and project-specific requirements outlined in the project management plan (see 4.9, Process Control). The division also must develop guidance that shows how projects are selected.

##### **Guidance**

The development of project-specific quality assurance plans is especially important for determining and defining customer requirements, industry practices, and safety and environmental concerns when each project is unique and particularly when those requirements may conflict. The quality assurance plans developed by field activities for each project should define how requirements will be met for specific contracts or products.

The division must plan and implement a quality system that covers

- ◆ preparation of a quality manual and project-specific quality management plans;
- ◆ identification of controls, resources, and skills necessary to achieve the requirements specified in the project management plan, quality assurance plans, or other contract;
- ◆ update of quality assurance and design review processes and techniques, as necessary;
- ◆ compatibility of the design planning, design development, and review and approval procedures; and

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- ◆ identification and preparation of quality records necessary to meet the requirements of the ISO 9001 elements.

## **GUIDELINES FOR CONFORMITY**

- Does the organization have a quality manual that fully documents its quality system, and is that manual in a form that is readily accessible and understood by all employees? Does the manual reference relevant standard operating procedures?
- Does the quality manual cover preparation of project quality assurance plans; identification and acquisition of controls, processes, inspection and testing equipment, design resources, and skills needed to achieve the required quality; clarification of standards for acceptability of products; compatibility of the design, design processes, and review and approval procedures; and identification and maintenance of quality records?
- Has the organization established and documented procedures for preparing quality assurance plans in accordance with the specific customer requirements?
- Has the organization established and documented procedures for updating, as necessary, quality assurance and design review techniques?
- Has the organization established and documented procedures for verifying compatibility of the design products to its intended initial requirements—in other words, for ensuring that the customer gets what it wants?

## **4.3 Contract Review**

### **4.3.1 GENERAL**

#### **Requirement**

This element requires the division to have a documented contract review system that

- ◆ ensures that its customers' requirements are defined, documented, and understood before the "contract" is finalized (e.g., a properly developed statement of work);
- ◆ effectively resolves misunderstandings with customers' requirements when they arise;

- ◆ ensures that it is capable of meeting the requirements, with in-house personnel or through subcontracted support, before entering into that agreement for engineering activities; and
- ◆ keeps records of all above-related discussions and agreements reached (see 4.16, Control of Quality Records).

Note: “Contract” refers to any contractual arrangement—including MOAs, MOUs, DD 1391s, delivery orders, task orders, and any other contracting vehicle—between the division and its customer (internal or external).

#### Guidance

If it is to deliver a quality product, the division must thoroughly understand what its customers want, need, and expect before it accepts and starts any work. And, it is the division’s responsibility to ensure that those requirements and expectations are effectively communicated. The division should not depend on its customers to express their expectations; instead, customers will expect the division to know.

#### 4.3.2 REVIEW

##### Requirement

The following are the basic requirements of the contract review process:

- ◆ Customer requirements must be adequately defined, agreed to by both parties, and documented (records kept).
- ◆ Any final requirements that differ from those in the proposal or tender must be resolved.
- ◆ The organization must understand the requirements of the contract and know its capabilities in meeting those requirements.

#### Guidance

Establishing and reviewing contracts with external customers is beyond the engineering or construction division’s authority, but making sure it is capable of delivering the work promised is not. The division should participate in as many preliminary meetings as possible between outside customers and the district’s contracting or project management divisions to ensure that its views are represented and to sign off on any agreements reached. Those contract review procedures should have the following features:

- ◆ An opportunity for all parties to review the contract
- ◆ A verification checklist

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- ◆ A method for questioning contract requirements and resolving problems
  - ◆ Provision for changing the contract.

The organization should include a finalized statement of work in the quality assurance plan for each project to serve as an ongoing reference.

The ISO standards cover precontract tender arrangements, as well as contract and ordering requirements. The terms “contract” and “accepted order” are further defined, as any requirements agreed to by both parties, transmitted by any means (including verbal orders). In that situation, the organization must make sure those requirements are agreed upon before their acceptance.

#### 4.3.3 AMENDMENT TO CONTRACT

##### Requirement

All modifications to an agreed-upon scope of work must be conducted in accordance with documented Army, district, and division procedures; the Federal Acquisition Regulation (FAR); and FAR supplements. As a minimum, procedures must include a review, notification to affected functions, and records of the contract agreements reached.

##### Guidance

Only those contract modifications dealing with the customer’s changes to the initially agreed-upon requirements need to be addressed. Other modifications are addressed under 4.10.3, In-Process Inspection and Testing. Modifications exceeding the administrative contracting officer’s authority must be coordinated with the contracting officer at the district office or above.

#### 4.3.4 RECORDS

The division must create and maintain records of all contract reviews and amendments to that contract. The personnel conducting contract reviews and amending contracts must be identified and recorded (see 4.16, Control of Quality Records).

#### GUIDELINES FOR CONFORMITY

- Are contract review activities applied to all contracts? Does the procedure for contract review deal with verbal orders?
- Has the organization established, written, and reviewed its procedures to ensure that all customer requirements are adequately defined and documented?

- Has the organization established written procedures for resolving conflicts with its customers concerning development of the requirements?
- Has the organization established written procedures to ensure that its contractors or in-house staff have the capability of meeting the customers' stated requirements before the contracts are signed?
- Are records of all contract reviews maintained, and are the people who conducted those reviews identified?

## 4.4 Design Control

### 4.4.1 GENERAL

The ISO 9001 standards require that the engineering division have documented procedures for establishing project quality assurance plans for managing the design process of E&D products and for verifying that those final products meet the requirements specified by the customers, internal policy, industry standards, and Army/USACE regulations.

Design control is not applicable to quality system requirements of USACE construction activities and is not an element under ISO 9002. However, on some projects, changes to facility designs may be necessary. For those cases, construction must document how it will handle such changes. The documentation should include an explanation of how the changes are authorized and how they get implemented. Element 4.5.3, Document and Data Changes, contains further guidance.

### 4.4.2 DESIGN AND DEVELOPMENT PLANNING

#### Requirement

The engineering organization must prepare quality assurance plans for the design and development process for every project; such plans should reflect any prior planning established in project management plans. The plans must elaborate on each engineering activity performed to ensure that the design meets the customer's stated requirements, industry specifications, and Army/USACE and local regulations. The plan also must assign the responsibilities to qualified engineering organizations that have adequate resources to perform the jobs. Design plans and quality assurance plans must be approved by management and must be updated, as necessary.

A design planning framework using project-specific quality assurance plans, will

- ◆ show how project designs are initiated and updated;

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- ◆ effectively demonstrate who will execute the design (in-house or an A-E contractor);
  - ◆ identify technical and informational interfaces between various engineering and other district activities (e.g., show who is in charge of what);
  - ◆ establish the responsibilities and the procedures for identifying, documenting, verifying, and resolving ambiguous or conflicting design requirements;
  - ◆ establish procedures for ensuring that completed designs conform to properly developed customer requirements as well as to any other regulatory requirements;
  - ◆ assign design review and approval responsibilities (see 4.10, Inspection and Testing);
  - ◆ establish procedures to identify and document design changes or modifications;
  - ◆ demonstrate how the finished design will meet the customer's requirements; and
  - ◆ establish biddability, constructability, and operability (BCOE) review procedures for construction division personnel to carry out.

#### Guidance

The essential quality aspects of an E&D product, such as cost, schedule, environmental compliance, safety, performance, dependability, etc., are established during the design planning phase. Thus, deficient design planning can be a major cause of quality problems and, subsequently, affect customer satisfaction with the finished product. The engineering division should consult guidance established in ER 1110-10-12, Quality Management, for further guidance on preparing the required quality assurance plans for each project.

Following ER 1110-1-12, project quality assurance plans should be sufficiently specific and detailed to permit effective verification during the review and approval steps. Planning procedures should take into account

- ◆ sequential and parallel work activities;
- ◆ design verification activities;
- ◆ safety, performance, and other quality aspects incorporated in the design;
- ◆ design acceptance criteria; and

- ◆ assignment of responsibilities.

#### **4.4.3 ORGANIZATIONAL AND TECHNICAL INTERFACES**

Design inputs and other information used during the design development process can come from a variety of sources (internal engineering personnel, the A-E contractor, the customer, experts subcontracted by the customer, USACE headquarters, etc.). The responsibilities and authorities of those internal and external sources must be defined, documented, coordinated, and controlled. The basic requirement of this element is to

- ◆ identify interfaces (particularly design review and verification responsibilities) between engineering division branches, between the engineering division and other district organizations (such as the project management, contracting, construction, and resource management divisions), and between the engineering division and its customers and their proponents;
- ◆ identify requirements and responsibilities of the BCOE review; and
- ◆ document and regularly review the transmission of necessary information.

#### **4.4.4 DESIGN INPUT**

##### **Requirement**

Before work begins, the engineering organization must

- ◆ identify all design input requirements pertinent to the product (e.g., the customer's requirements, engineering regulations, local or federal statutes, A-E instructions, design specifications, standard design elements, or any other design specifications);
- ◆ review those requirements for adequacy;
- ◆ resolve, with internal or external customers, any incomplete, ambiguous, or conflicting requirements; and
- ◆ document and maintain records of those requirements for each project.

##### **Guidance**

Inputs for a typical engineering project design can come from a number of sources. Specifically, design inputs can be design criteria and specifications from the Corps of Engineers guide specifications, other engineering division publications, industry criteria, and manufacturers' specifications. Other forms of design inputs may be user-generated performance specifications, a statement of work, A-E instructions, and any other applicable statutory or regulatory requirement.

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#### **4.4.5 DESIGN OUTPUT**

The engineering organization must produce a finished E&D product (design specifications, drawings, studies, etc.) in a format that can be verified against the initial contract requirements and design inputs outlined above. Engineering products must

- ◆ meet the design input requirements,
- ◆ contain or reference acceptance criteria,
- ◆ identify design characteristics crucial to safety, and
- ◆ be reviewed and approved by a designated engineering division authority before it is released as a finished product.

#### **4.4.6 DESIGN REVIEW**

##### **Requirement**

The engineering division must plan and conduct, at appropriate stages, formal reviews of the E&D product it develops. Dates and designated reviewers should be specified in the project management plan, the quality assurance plan, or both. Results of those reviews must be formally recorded.

##### **Guidance**

This element requires that design reviews be performed but does not specify when in the design development process they must be performed or who is to perform them. The current practice of reviewing the design at the conceptual, 35 percent, 60 percent, 90 percent, and 100 percent design completion stages is an acceptable procedure although not necessary for every project as long as appropriate reviews are specified in the project management and/or quality assurance plan. In addition, although not specifically mentioned, BCOE and peer reviews fall under this element. The requirement of this ISO element merely states that, sometime during the design development planning stage, engineering personnel should determine the appropriate points for design reviews and should identify who will conduct them, their responsibilities, and the expected results.

#### **4.4.7 DESIGN VERIFICATION**

##### **Requirement**

The engineering organization must verify that the in-process engineering product at various stages of the design process meets the specified requirements from 4.4.4, Design Input, for that stage as specified by the project management plan or

quality assurance plan. Records of design verification and the measures used must be recorded (see 4.16, Control of Quality Records).

#### Guidance

This element addresses the logical outcome from performing design reviews, which is to verify that the design meets the appropriate design input requirements at each stage. Design verification involves the individuals that perform design reviews. Examples of design verification include the following:

- ◆ Customary engineering design reviews—use of the Automated Review Management System (ARMS) is recommended
- ◆ BCOE and peer reviews
- ◆ Comparisons of new design elements to similar proven elements of previous designs or to design standards or Corps guide specifications
- ◆ Customer review and approval to proceed with the next stage design
- ◆ Tests of the mockup of the completed E&D product (or sections of the product) to ensure that the full-scale version will work as planned
- ◆ Tests, computer simulations, or demonstrations during the design stage.

#### 4.4.8 DESIGN VALIDATION

Design validation must be performed on all E&D products to ensure that the product sufficiently satisfies the customers' intended requirements as specified in the contract. The engineering division should validate its product through the customer and construction division prior to project completion.

Note: Sometimes, validation of the design will be possible only after the project is actually constructed. Since construction is not the responsibility of the engineering organization (and may not be applicable to all projects), the engineering organization can meet the requirements of this element through performance of design criteria feedback inspections.

#### 4.4.9 DESIGN CHANGES

##### Requirement

All changes to approved designs must be identified, documented, reviewed, and approved by authorized engineering division personnel before those changes are implemented.

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## Guidance

This element applies both to amendments made during the design development process and to design modifications after construction contract award. Sometimes, improving one characteristic may have an unforeseen adverse influence on another. The changes to the design should be communicated to all concerned (especially the customer) and should be documented.

### **GUIDELINES FOR CONFORMITY**

- Do the quality assurance plans identify the responsibility of each organization involved in the project, specify reasonable schedules, identify major activities, and review points, etc.?
- Are the quality assurance plans updated as the project evolves?
- Is the project schedule adequately developed, and are the various project activities assigned to qualified personnel equipped with resources to complete it effectively?
- Are organization and technical interfaces between different engineering organizations and other district elements identified, documented, and reviewed regularly?
- Are the organization's personnel notified of changes as the project evolves?
- Are customer requirements defined and incorporated during the design development process? Are adequate control mechanisms in place to ensure that they are met?
- Are statutory/regulatory requirements addressed during project planning?
- Are procedures in place for resolving incomplete, ambiguous, or conflicting requirements during the design development process?
- Are design verifications planned and conducted?
- Are various design elements validated?
- Are the quality assurance plans checked to ensure that they do not conflict with the customers' initial requirements addressed in the contract and project management plans?
- Are procedures adequate for identifying, documenting, reviewing, and approving all potential changes and modifications to the projects?

- Are procedures in place for conducting BCOE and peer reviews, and are those reviews effectively carried out for each project when appropriate?
- Is the ARMS effectively used?

## 4.5 Document and Data Control

### 4.5.1 GENERAL

#### Requirement

The engineering or construction division must have documented procedures for creating, distributing, controlling, reviewing, approving, and publishing internally and externally generated documents and data that relate to any applicable element of this standard or for any project. The organization will identify the documents and data it will control.

Note: Documents and data can be of any medium—hard copy or electronic.

#### Guidance

Document control applies to all documents and data pertinent to project planning, purchasing, supervision and review, quality standards, design reviews and verification, testing, and internal written procedures. Internal written quality system procedures covering this element should describe

- ◆ what documents and data are to be controlled,
- ◆ how documentation for those functions should be controlled,
- ◆ who is responsible for document control (may be more than one person and specific documents may be controlled by different people), and
- ◆ where and when that control is to occur.

The following are examples of documents and data that the division may wish to control:

- ◆ Applicable federal statutes
- ◆ All Army and USACE regulations, pamphlets, circulars, and technical notes
- ◆ Corps of Engineers guide specifications
- ◆ Industry and local design standards and relevant codes

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- ◆ Standard designs
  - ◆ Project specifics (e.g., construction contract plans and specifications)
  - ◆ ISO 9000 quality manual and quality system procedures
  - ◆ Relevant work instructions
  - ◆ Training materials
  - ◆ Any other ISO-related quality documentation.

#### **4.5.2 DOCUMENT AND DATA APPROVAL AND ISSUE**

##### **Requirement**

The division must prepare a master list of documents and data that it intends to control. The list should include documents and data required by the customer. Authorized personnel must approve each entry on the master list before it is issued.

##### **Guidance**

To avoid using invalid or obsolete documents, division personnel must be able to identify the current revision status of the controlled documents and data, and they must ensure that current and appropriate documents and data are available at all relevant locations where needed. The division must remove invalid or obsolete controlled documents or otherwise handle them to ensure against unintended use, and it must identify any obsolete documents retained for legal or knowledge-preservation purposes.

#### **4.5.3 DOCUMENT AND DATA CHANGES**

##### **Requirement**

When changes to controlled documents or data are necessary, cognizant engineering or construction activities or personnel must identify and approve the changes. The review and approval process must be performed by the same activities or people that performed the original review (unless specifically designated otherwise); those activities or people must have access to appropriate information upon which to base their decisions. The organization must consider whether the changes should be identified, either within the documents that have been changed or in appropriate change notifications.

## Guidance

This element applies to all internally and externally controlled documents and data. The division should consider the effect that changes in one area may have on other parts of the organization and should plan the circulation of a change proposal to avoid disruption as well as time the implementation to minimize disruption.

## **GUIDELINES FOR CONFORMITY**

- Does a master list of all essential documentation exist to ensure that the most up-to-date documents are in place where they are needed and to ensure that outdated or nonapplicable documents are never used?
- Are documents approved before being issued?
- Are mechanisms in place for controlling the issue of all pertinent documents?
- Are document changes reviewed and approved by the same activities that performed the original issuance (if issued internally)?
- Before being entered into the system, are all documents checked for appropriate levels of review and approval?
- Is there a policy for reissuing documents after a certain number of revisions/changes?

## **4.6 Purchasing**

### **4.6.1 GENERAL**

#### Requirement

This element requires that the division have documented procedures to ensure that all purchased goods and services conform to the requirements set forth in the contract, project management plan, and/or quality assurance plan. In addition, this element requires that all A-E, construction, and other service contractors be selected on the basis of their ability to meet the requirements specified in the contract (see 4.3, Contract Review). The acquisition process employed for all engineering or construction subcontractors must conform to the requirements of local contracting procedures, the FAR, and FAR supplements.

Note: This element does not apply to engineering or construction organizations that do not need to purchase goods or services in order to deliver their product or that have little or no influence over the selection of the general contractors.

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## Guidance

Purchasing procedures that are planned and adequately controlled ensure that subcontracted products conform to the specified requirements. The division should establish effective working relationships and feedback systems with all its subcontractors, engineering laboratories, general construction contractors, and others. A quality procurement program should include

- ◆ quality assurance procedures for planning and controlling subcontracted products,
- ◆ criteria for selecting acceptable subcontractors,
- ◆ agreement with subcontractors on quality assurance,
- ◆ agreement with subcontractors on verification methods,
- ◆ provisions for settling disputes between USACE and the subcontractor, and
- ◆ quality records related to purchasing.

### 4.6.2 EVALUATION OF SUBCONTRACTORS

#### Requirement

By law, procurement of A-E and construction contractors is the responsibility of the district's contracting officer and must comply with the FAR and FAR supplements. However, when requested, the engineering or construction division must evaluate those contractors and their abilities to make sure that they are capable of fulfilling the project requirements.

During execution of any contract, division personnel must monitor the contractor's performance against the contract and provide the necessary feedback to the contracting authorities so that poor performers can be eliminated from consideration for subsequent contracts. The organization must

- ◆ evaluate and select contractors based on their ability to meet the requirements,
- ◆ establish and maintain records of acceptable and unacceptable contractors, and
- ◆ define the type and extent of control exercised over subcontractors.

## Guidance

Divisions that properly use the A-E Contract Administration Support System (ACASS) and the Construction Contract Administration Support System (CCASS) will meet the requirements of this element. The subcontractor's quality records should be sufficiently comprehensive to demonstrate its ability to meet the project requirements. The division may employ one of several methods for choosing satisfactory contractors. For example, a subcontractor may be assessed on the basis of previous performance, registration to ISO 9000 or other quality system standard, or some other appropriate quality system standard.

### 4.6.3 PURCHASING DATA

For all services, materials, and supplies purchased by the engineering or construction organization, the required contracting documents must clearly identify what is being purchased. Where applicable, the division must support the contracting officer in developing the statements of work for products or services needed. The requirements for purchasing data include the following:

- ◆ In the purchasing document, clearly and specifically describe the product or service required.
- ◆ Review and approve purchasing documents for adequacy of specified requirements.

### 4.6.4 VERIFICATION OF PURCHASED PRODUCT

Conformity of the subcontracted product to specifications may be verified by (1) USACE engineering or construction staff at the contractor's or subcontractor's premises or (2) the customer at the contractor's or subcontractor's premises, USACE premises, or the point of installation. In the first situation, USACE must "specify verification arrangements and the method of product release in the purchasing documents." In the second situation, the ISO standard adds two caveats:

- ◆ Verification by the customer cannot be used by the engineering or construction organization as evidence of effective quality control by the subcontractor.
- ◆ Verification by the customer does not absolve USACE of responsibility for providing a quality product.

## GUIDELINES FOR CONFORMITY

- Do procedures and specifications exist for all goods and services purchased or contracted by the organization? Is there a system in place to ensure that all purchased goods and services conform to those specifications?

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- Are contractors selected on the basis of their ability to meet requirements?
  - Does the organization currently evaluate the quality systems used by contractors, and are the quality systems evaluated on the basis of past experience, on-site visits, and/or their registration under the ISO or similar standards?
  - Are contracts, purchase orders, and delivery orders always reviewed to ensure that they contain the necessary requirements?
  - Is ACASS routinely queried before subcontracting for A-E services?

## 4.7 Control of Customer-Supplied Product

### GENERAL

#### Requirement

The engineering or construction division must document its procedures for ensuring that any materials or products supplied by the customer for use in the product to be delivered to the customer are properly stored and maintained and are verified before they are used. The loss of or damage to any customer-supplied products, as well as the delivery of unsuitable products supplied by the customer, must be recorded and reported to the customer. The standards require that records of all customer-supplied products be kept.

#### Guidance

Most USACE engineering divisions rarely receive tangible materials from their customers for inclusion in an E&D product. In nearly every situation, the materials supplied by their customers are documentation or data and therefore fall under the provisions of 4.5, Document and Data Control, to satisfy the requirement for proper handling and verification before use; the provisions of 4.16, Control of Quality Records, to satisfy the requirements for proper storage and maintenance; and the provisions of 4.13, Control of Nonconforming Product, to satisfy the requirements of reporting unsuitable conditions back to the customers.

Documentation and data that may be received from the customer and that fall under those requirements may include local engineering or design specifications, legal documentation, design criteria, product brochures, computer equipment, software, as-built drawings, local design standards, or any other items owned by USACE customers and furnished for use in meeting the contract requirements.

The engineering division may wish to develop documented procedures covering the requirements of this element in the event it ever does take possession of materials other than documentation and data.

Construction divisions may receive government-furnished materials procured by the customer for use in a constructed facility. They may also be any materials procured by the district contracting activity to use as the construction site. Finally, customer-supplied products may be specifications, legal documentation, product brochures, blueprints, computer equipment, software, procedure manuals, or any other items that are owned by the customer and furnished to the construction organization for use in meeting the contract requirements.

#### **GUIDELINES FOR CONFORMITY**

- Are customers' as-built drawings, design guides, procedure and operating manuals, and preliminary design documents effectively controlled according to 4.5, Document and Data Control, while they are being used, and if requested, are they returned to the customers when the project is complete?

### **4.8 Product Identification and Traceability**

#### **GENERAL**

##### **Requirement**

The division must have a documented system to ensure that its products are uniquely identifiable and traceable through all stages of the project. For example, if errors in the end product are discovered, the designs must be traceable to the stage at which problems occurred so that the organization can perform an effective audit of the root causes of the problems.

##### **Guidance**

Many identification methods exist, but at a minimum, all products (plans and specifications, drawings, studies, etc.) should be numbered according to a pre-established convention. The identifier should be unique to the project and the source of the operation. Separate identifiers could be required to record changes in various aspects of the project. Traceability may require that specific personnel involved in phases of the operation be identified, which can be accomplished, for example, through signatures on serially numbered documents.

#### **GUIDELINES FOR CONFORMITY**

- Are all designs and products adequately and uniquely identified?
- Is a system in place to ensure that products are traceable?

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## 4.9 Process Control

### GENERAL

#### Requirement

The organization must plan, identify, and document the processes and activities that directly affect the quality of the finished product. In addition, those processes/activities must be carried out in a controlled manner. Consideration must be given to the following:

- ◆ Documenting procedures and work instructions, using suitable test equipment or computer models, and ensuring suitable working environments
- ◆ Knowing and complying with applicable federal and state laws, environmental regulations, industry codes, design criteria, safety standards, Army and USACE regulations, etc.
- ◆ Developing criteria for determining acceptable performance
- ◆ Monitoring the progress of projects against the project management and quality plans and resolve problems that arise (design errors, differing site conditions etc.).

#### Guidance

Preventing problems by controlling processes is better than discovering problems after the project has been completed. To get its processes under control, a division should consider

- ◆ conducting process capability studies to evaluate the effectiveness of its processes,
- ◆ developing work instructions that describe the criteria for determining satisfactory work completion and conformity to standards of good workmanship, and
- ◆ verifying the quality status of the product and process.

Documented work instructions should include

- ◆ methods of accomplishing the work,
- ◆ tools and equipment needed to perform the tasks,
- ◆ sequences of activities,

- ◆ monitoring requirements,
- ◆ necessary review and approval requirements,
- ◆ standard designs used when and where appropriate, and
- ◆ sampling requirements, where appropriate.

For USACE engineering organizations, this element identifies the same quality system requirement as 4.4, Design Control, since design development is the engineering division's primary activity. Therefore, requirements of 4.4, Design Control, and 4.9, Process Control, should be considered complementary. However, this element adds the requirement for control of equipment used and service activities.

## **GUIDELINES FOR CONFORMITY**

- Have adequate procedures and work instructions—for example, critical path activity networks—been established describing how to perform all activities?
- Are critical activities monitored?
- Do standards for what constitutes acceptable performance exist in relation to performance of process activities?
- Do personnel know what variables in the process are important to achieve excellent quality?
- Are detailed process instructions and procedures established and well documented, and are they easily understood by those who must use them?

## **4.10 Inspection and Testing**

### **4.10.1 GENERAL**

#### **Requirement**

The division must have documented systems and procedures for effectively inspecting and testing (e.g., reviewing and approving) all incoming products from outside subcontractors and vendors (e.g., A-E contractors), all in-process activities, and the final product before it is delivered to the customers to ensure that the product conforms to the requirements established in the project management plan and quality assurance plan.

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## Guidance

Since the primary responsibility of an engineering division is design development, the design review and verification provisions required by 4.4, Design Control, are essentially the same provisions directed by 4.10, Inspection and Testing. Therefore, the two separate quality system requirements should be considered complementary.

### 4.10.2 RECEIVING INSPECTION AND TESTING

#### Requirement

When it receives a product from any of its contractors (see 4.6, Purchasing), the division must ensure that the product fulfills contractual obligations and that no subcontracted work is used or further processed until it has been verified and approved in accordance with the contract requirement, project management plan, quality assurance plan, and other documented procedures. However, for any work required for urgent release, the division must ensure that the product is properly and uniquely identified to permit positive recall, if necessary. A log of all incoming and rejected products must be maintained.

#### Guidance

Nearly all of an engineering division's incoming products will be from A-E contractors, test laboratories, or engineering-related inspections; therefore, 4.6, Purchasing, is complementary to this element of the standard. This element does not imply that incoming items must be inspected and tested if the engineering organization is confident that other quality verification procedures would suffice. Quality verification procedures may include

- ◆ provisions for verifying contracted A-E work, materials, or engineering services against preestablished requirements, and
- ◆ provisions for taking action when subcontracted work does not conform.

The engineering organization should keep appropriate records to ensure the availability of historical data to assess A-E subcontractor performance and quality trends. The records should serve as input into ACASS.

Note: The urgent release of any E&D products, even if subject to recall, should generally be discouraged as a matter of good quality management practice.

For a construction division project, personnel must verify that off-site testing is being performed in accordance with the quality assurance plan or with the contractor's quality control plan and industry guidelines and must ensure that the test samples apply to the product to be supplied. For building equipment or materials inspected off site, verification must be performed per 4.6.4, Verification

of Purchased Product. When the equipment or material is delivered, construction must validate that it is the same equipment or material examined and approved off site. When construction uses materials before they are validated, it must document where they were used. For example, if it pours concrete before it receives compression test results, construction should document the location of that pour.

#### **4.10.3 IN-PROCESS INSPECTION AND TESTING**

##### **Requirement**

The division must ensure that in-process testing and inspection are performed as required by the project management plan, quality assurance plan, or the contractor's quality control plan. It should not permit the work to advance until the required testing and inspections have been completed and approved. (For example, local inspections of electrical work may be necessary before walls can be closed.) The exception is when work is released under positive recall procedures; the release under positive recall procedures, however, would not preclude the test and inspection steps required above.

Nonconforming work should be handled according to 4.13, Control of Nonconforming Product, except when work is released under positive recall procedures. The release under positive recall procedures, however, would not preclude the previous review and approval steps required above. Contract modifications needed because of design errors or differing site conditions must be handled according to the contract requirements, FAR, and FAR supplements.

##### **Guidance**

In-process inspection and testing applies to all forms of products. It allows nonconformities to be found early and resolved. Statistical control techniques can be used to identify process trends that are out of control and to prevent future problems (see 4.20, Statistical Techniques).

#### **4.10.4 FINAL INSPECTION AND TESTING**

The division, in accordance with documented procedures and with the project management and quality assurance plans, must carry out final test and inspection of the product before it is delivered to the customer. The customer also may conduct a final inspection. The final review and acceptance criteria must be specified in the quality management plan or other documented procedures.

#### **4.10.5 INSPECTION AND TEST RECORDS**

##### **Requirement**

The division must establish and maintain records that indicate whether the product has passed in-process and final inspections and tests done in accordance with the

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project management plan and quality assurance plan. Those records must identify the inspection authority responsible for releasing the product. The records may include punch lists, local buildings and trade inspections, building certification forms, transfer deeds, and inspection logs.

#### Guidance

Records must be kept in accordance with 4.16, Control of Quality Records. They will facilitate future assessments, including regulatory compliance and possible liability issues.

#### GUIDELINES FOR CONFORMITY

- Do documented procedures exist that identify what review and validation is required and what records must be established?
- Is there a system in place to ensure that the work contracted to outside firms and other purchased services is of acceptable quality?
- Are inspection and review procedures performed in accordance with the quality assurance plan, project management plan, or other documented procedures?
- Are conforming and nonconforming products clearly identified, and does the system provide procedures for rejecting unacceptable work?
- Do product failures trigger procedures for centrally controlling nonconforming products?
- Are procedures in place for reviewing and approving in-process designs, and do those procedures handle the rejection of in-process work?
- Are all designs released only after a final review confirms that release of the designs and other products is acceptable?
- Are records maintained showing that designs have passed a final review and specifying what the final review criteria were and who authorized their release?

## 4.11 Control of Inspection, Measuring, and Test Equipment

### 4.11.1 GENERAL

The engineering or construction organization that uses in-house or field inspection and testing equipment must have documented procedures for controlling that equipment. The organization should

- ◆ identify which measuring and test equipment must be controlled and calibrated;
- ◆ establish and maintain documented procedures to control, calibrate, and maintain any equipment used for reviewing, validating, measuring, and testing that demonstrate conformance to established requirements;
- ◆ use any such equipment in a manner that ensures that measurement uncertainty is known and is consistent with the required measurement capability;
- ◆ check and recheck the capability of any test software or hardware used as forms of design review, cost estimating, or engineering analysis; and
- ◆ when requested by the customer, provide technical data for any needed equipment.

### 4.11.2 CONTROL PROCEDURE

#### Requirement

Where required, the organization must identify the necessary measurements; the accuracy required; the appropriate inspection, measuring, and test equipment needed; and the computer or test models to be used during the review and verification process. Where such equipment is deemed necessary, the organization must

- ◆ identify, calibrate, and adjust all equipment in accordance with the quality assurance plan, relevant American Society for Testing and Materials standards, relevant military standards, and test equipment manufacturers' instructions;
- ◆ establish, document, and maintain calibration procedures;
- ◆ ensure that the equipment used is capable of the required accuracy and precision;
- ◆ be able to identify equipment to indicate calibration status;

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- ◆ assess the validity of previous results when equipment is out of calibration;
  - ◆ ensure suitable conditions for calibration, inspection, measurement, and testing;
  - ◆ ensure accuracy and fitness for use when handling, preserving, and storing equipment;
  - ◆ safeguard inspection, measuring, and test facilities; and
  - ◆ maintain calibration records.

#### Guidance

The control of measuring and test equipment and test methods should address the following factors, as appropriate:

- ◆ Suitable specification and acquisition
- ◆ Initial calibration prior to first use to validate required bias and precision
- ◆ Periodic recall for adjustment and recalibration to maintain required accuracy in use
- ◆ Documentary evidence that covers instrument identification, calibration status, and handling procedures
- ◆ Traceability to accurate and stable reference standards.

#### GUIDELINES FOR CONFORMITY

- Is test equipment (e.g., electronic survey, piezometers, and survey boat equipment) properly controlled and periodically calibrated?
- Are computer models periodically reviewed and updated as the model assumptions, boundaries, and analytic data change?
- Does the organization maintain records of calibrations—the results, accuracy, and precision—and the status of the equipment?

## 4.12 Inspection and Test Status

### GENERAL

#### Requirement

The engineering or construction division must ensure that the inspection and test status of each product is identified. Status identification ensures that the product being designed is acceptable. In addition, the people responsible for releasing finished products must be identified and documented.

#### Guidance

The status identifier should be part of the same preestablished convention defined in 4.8, Product Identification and Traceability, and should indicate whether the product

- ◆ has not been reviewed,
- ◆ has been reviewed and accepted to what design stage,
- ◆ has been reviewed and is on hold awaiting decision, or
- ◆ has been reviewed and rejected (see 4.13, Control of Nonconforming Product).

The use of the ARMS is appropriate and satisfies the intent of this element, but verification status could be identified by any suitable means such as stamping, design approvals, approval blocks on reports or studies, notations, review records that accompany the product, or by physical location.

### GUIDELINES FOR CONFORMITY

- Is both conforming and nonconforming design work marked to indicate current status, and do other engineering or construction personnel have access to and know the status of in-process work?
- Do those personnel who utilize contracted work know what its quality is or its level of acceptability?
- Do personnel know who is able to release work or reject unacceptable work?
- Is a system in place for releasing acceptable products?
- Are adequate records kept to indicate the status and inspection authority responsible for releasing finished designs?

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## **4.13 Control of Nonconforming Product**

### **4.13.1 GENERAL**

#### **Requirement**

The inadvertent use of any nonconforming product that does not meet stated requirements must be minimized. The organization must have systems and procedures in place to ensure that no product with identified errors reaches the customer. All reworked products must be reinspected in accordance with the provisions of the quality assurance plan.

#### **Guidance**

A nonconforming product is one that fails to meet the stated requirements or industry specifications. Controlling a nonconforming product requires procedures for

- ◆ identifying and documenting nonconforming components of a product,
- ◆ evaluating the nonconformity,
- ◆ considering alternatives for correcting the nonconforming products,
- ◆ physically controlling the further processing of the nonconforming products, and
- ◆ notifying all activities that may be affected by the nonconformity.

### **4.13.2 REVIEW AND DISPOSITION OF NONCONFORMING PRODUCTS**

#### **Requirement**

The division must define who is responsible for reviewing and authorizing the disposal of nonconforming products and must document what is to be done with deficient product. Nonconforming products may be reworked, accepted without being reworked by concession of the customer, or rejected.

#### **Guidance**

The division should take actions to deal with nonconforming products as soon as indications occur that materials, components, or the completed product do not or may not meet the specified contractual requirements. The people who review nonconforming items should be competent to evaluate the effects of the decision of interchangeability, further processing, performance, reliability, safety, and aesthetics. A decision to accept a nonconforming product should be documented,

together with the reason for doing so, in authorized waivers, with appropriate precautions.

## **GUIDELINES FOR CONFORMITY**

- Does the organization have procedures for handling unacceptable work?
- Does the organization identify unacceptable work and ensure that unacceptable work is never released to its customers?
- Are adequate records kept indicating the disposition of unacceptable work?
- Is a procedure in place for reworking unacceptable work and making it comply with the appropriate standards and/or the customer's requirements?
- Is a procedure in place for notifying customers of unacceptable work and how that work will be disposed of or reworked to conform with requirements?
- Are reworked designs reviewed for conformance to the requirements?

## **4.14 Corrective and Preventive Action**

### **4.14.1 GENERAL**

#### **Requirement**

The engineering or construction organization must establish and maintain documented procedures for implementing corrective and preventive actions that are appropriate to "the magnitude of problems and commensurate to the risks encountered" for the product, process, and quality system nonconformities. Records must be kept of any changes to documented procedures that result from taking corrective or preventive actions.

Note: Corrective action is directed at eliminating the causes of *actual* nonconformities. Preventive action is at toward eliminating the causes of *potential* nonconformities.

#### **Guidance**

This element explains what the organization must do when things go wrong. An ongoing and viable lessons-learned program that utilizes records generated under 4.13, Control of Nonconforming Product, can be a starting point for targeting specific problem areas. The organization should apply judgment as to when and

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where corrective or preventive actions are required or even cost-effective. Analysis of nonconformities can also be performed on records of design reviews, process monitoring audit observations, and all other available feedback methods. Procedures should

- ◆ establish who is responsible for taking corrective action,
- ◆ define how the action will be carried out, and
- ◆ verify the effectiveness of the corrective action.

Procedures should also take into account nonconformities discovered in any product that has already been completed, is in the process of being constructed, or has already been constructed.

#### 4.14.2 CORRECTIVE ACTION

When corrective action is required, the organization must

- ◆ effectively handle customer complaints and nonconformity reports,
- ◆ investigate and analyze the problem and record the results (nonconformities may be prioritized to determine which should be further investigated),
- ◆ determine the most effective corrective action to take, and
- ◆ ensure that corrective actions are taken effectively.

Records of the corrective action taken should be established (see 4.16, Control of Quality Records).

#### 4.14.3 PREVENTIVE ACTION

##### Requirement

When preventive action is required, the organization must

- ◆ use all available information—such as work processes, internal audit results, quality records, lessons learned, and customer complaints—to detect, analyze, and eliminate potential causes of nonconformities in engineering products, processes, and quality systems;
- ◆ determine a method for preventive action;
- ◆ initiate preventive action and ensure that it is effective; and
- ◆ submit any relevant information on actions taken for management review.

Records of the preventive action taken should be established (see 4.16, Control of Quality Records).

#### Guidance

Preventive actions are intended to eliminate the causes of problems in the organization's processes and its quality system. A system of considering and applying lessons learned from past projects during the early planning phase of new projects is one way to make sure that experiences gained from previous mistakes benefit the new project.

#### GUIDELINES FOR CONFORMITY

- Are procedures in place to identify and correct nonconformities?
- When work is found to be unacceptable, is the cause of the deficiency identified?
- Are preventive measures taken to preclude recurrences of common problems?
- Are corrective and preventive actions submitted to management for review?
- Does the organization analyze risk versus reward or return on investment to verify that the corrective actions taken are effective?
- Are quality system elements, processes, and procedure documentation identified and changed as the result of such corrective or preventive actions?
- Has the organization prepared a form designated for corrective actions, and are those forms logged and maintained?
- Are the implementation and effectiveness of preventive actions evaluated and recorded?

### 4.15 Handling, Storage, Packaging, Preservation, and Delivery

#### GENERAL

#### Requirement

The division must have procedures to handle, store, preserve, and package project equipment and materials that are under its control. Typically, the procedures should address technical and American Society for Testing and Materials

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specifications and GFE regulations, maintenance of test samples, preservation requirements for long-term storage, etc.

#### Guidance

The requirements of this element are not applicable to construction divisions that do not use GFE or customer-supplied products. However, it does apply to engineering divisions. Their quality systems should provide for

- ◆ secured storage (whether physical storage or in electronic format) to protect in-process designs from theft, deterioration, misuse, or unauthorized revision;
- ◆ good quality reproduction systems to ensure that customers get the quantity of designs needed and in an acceptable condition;
- ◆ appropriate methods for preserving and segregating the E&D products when they are under the engineering organization's control;
- ◆ protection of product quality after final reviews, including delivery to customers;
- ◆ appropriate protection against damage, deterioration, or contamination as long as the material remains the responsibility of the engineering organization;
- ◆ a clear description of the contents, according to regulation or contract; and
- ◆ confirmation of packaging effectiveness.

If any aspect of handling, storage, packaging, preservation, or delivery of E&D products or information is subcontracted to an agent outside the engineering division, then the provisions of 4.6, Purchasing, apply.

#### GUIDELINES FOR CONFORMITY

- Does the organization maintain procedures for the effective handling, storage, packaging, distribution, and delivery of in-process and final products?
- Does the organization ensure that its method of handling its product effectively minimizes the risk of damage or deterioration?
- Are the correct number of copies of plans and specifications prepared to minimize waste but satisfy needs?
- Are storage locations (paper files and electronic storage) secure to prevent damage, deterioration, or theft?

- Can stored plans and designs be located and retrieved easily?
- Do procedures exist for packaging and delivering the finished product to customers?
- Are stored designs periodically inspected to determine obsolescence?

## 4.16 Control of Quality Records

### GENERAL

#### Requirement

The engineering or construction organization must establish and document procedures for creating, keeping, maintaining, retaining, distributing, using, and disposing of all quality system records (which may be in the form of paper, electronic media, or photographs). All quality records must be legible and identifiable to the product involved. The procedures should specify the people responsible for the records management system, types of records to be maintained, system security, retrieval procedures, retention intervals, means of disposal, and a system for making quality records available to customers and auditors. Records management must be in accordance with the Modern Army Record Keeping System.

#### Guidance

Quality records should, at a minimum, consist of

- ◆ internal management review records,
- ◆ project management plans and quality assurance plans from completed projects,
- ◆ contract review agreements (acquisition strategy meeting minutes),
- ◆ design reviews and verifications,
- ◆ internal quality system audits,
- ◆ measuring and test equipment calibration results,
- ◆ personnel training,
- ◆ purchase orders,
- ◆ change orders, and
- ◆ corrective and preventive actions taken.

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Quality records are referred to throughout ISO 9001. The purpose of the records is to demonstrate that the quality system is effective and that the product or service meets the requirements—that the division is doing what it says it is doing. The records should be readily accessible and retained for at least 3 to 4 years or as specified by contract or regulation.

Sometimes, customers may require that the organization store and maintain, for a specified part of the operating lifetime, selected records that attest to the quality of products (particularly for civil works projects) or that it retain design work that may be used on future projects or may be needed for legal reasons. The organization must be able to provide such documents to the customer, as required under specific circumstances.

#### **GUIDELINES FOR CONFORMITY**

- Is a system in place for the identifying, collecting, indexing, filing, storing, maintaining, and disposing of the organization's quality records?
- Are all records legible, properly identified, and marked?
- Are records easily archived and retrievable? (If controlled, is access prevented?)
- Are all records stored in such a way to preclude damage and deterioration over time?
- Are there policies for retention and disposal?
- Where agreed contractually, are records accessible by the organization's customers?

### **4.17 Internal Quality Audits**

#### **GENERAL**

##### **Requirement**

The division must establish and maintain documented procedures for comprehensive and systematic (planning, performing, reporting, and follow-up) quality system audits. The audits must be carried out by properly trained and authorized personnel whose regular responsibilities are outside of the area being audited. The audits must be effectively scheduled according to the status and importance of the activity, and records of the findings and follow-up actions must be maintained. The procedures for quality audits must make sure that responsible personnel are notified of any deficiencies so that they can take timely corrective

action. The results of that corrective action must be recorded, and its effectiveness noted in follow-up internal audits.

#### Guidance

Internal quality audits are the mainstay of quality system conformance and a powerful tool that will enable continuous improvement. The purposes of internal audits are to ensure that the organization's quality system is working according to its documented plan to meet customer requirements, to comply with regulatory requirements, and to provide opportunities for improvement.

Normally every area within the organization should be audited at least annually; areas consistently having problems should be audited more often. A full audit plan should be developed and documented; the plan should include details for the corrective and preventive action systems. Within a division, members of one branch may audit another branch, and members of a project team may audit another project team, or the division may utilize an outside organization, such as the district internal review organization. Under no circumstances should a branch chief audit any area under his or her responsibility, nor should a project engineer audit a project under his or her control.

#### GUIDELINES FOR CONFORMITY

- Are quality audits conducted within each branch or section to verify whether quality activities comply with established procedures?
- Does an internal audit schedule exist?
- Are internal audits conducted in accordance with the established procedures?
- Are audits performed by personnel outside of the functional activity being audited?
- Does the audit body communicate the results of those audits back to the cognizant branch or section manager?
- Are corrective actions taken as the result of the audits, and are those changes followed up and are they determined to be effective?
- Have the internal auditors been adequately trained, preferably through ISO 9000 auditor training programs?
- Are quality audit records adequately maintained, and are those records kept at least until the next audit is performed?

- 
- Are audit results used as a basis for future audits?

## 4.18 Training

### GENERAL

#### Requirement

The organization must have documented procedures for identifying training needs for every member of its staff. The organization must make sure that all of its personnel are effectively trained to carry out their responsibilities in a way that is consistent with the documented quality system. The documented training program should teach quality and quality management issues to all personnel who directly affect the quality of service, reconcile needed skills with skills possessed by every member of the organization, be adequately funded, evaluate the effectiveness of the training, and conduct post-training assessments. Records of employee training and training status must be kept.

#### Guidance

Training is essential to achieving quality results. The organization should utilize the training system already established by the Army's Individual Training Program and follow the broad career development guidance established by USACE headquarters. Within that program, training should encompass the use of, and underlying rationale for, the quality management approach of the organization. In the training process, the division should

- ◆ evaluate the education and experience of all personnel;
- ◆ identify individual training needs by job function;
- ◆ provide the appropriate needed training, either in-house or externally;
- ◆ record training progress and keep records up to date to identify training needs;
- ◆ encourage development and maintenance of industry-specific expertise, particularly when that expertise is critical to ongoing project work; and
- ◆ encourage professional registration and certifications.

The division should consider training people at all organizational levels performing activities affecting quality. The training should include newly recruited personnel and personnel transferred to new assignments. Executives and managers also require training in the understanding of the quality system and of the tools and techniques needed to operate the system.

## **GUIDELINES FOR CONFORMITY**

- Is a procedure in place and documented for identifying training needs for all personnel performing activities affecting product quality?
- Are personnel adequately trained in skills and knowledge to perform their jobs?
- Do training records exist for all employees, and are they properly maintained?
- Is there a central organizational entity that maintains training records and programs?
- Does the training program cover quality awareness for all personnel?
- Does the training program cover revisions to existing procedures?

## **4.19 Servicing**

### **GENERAL**

#### **Requirement**

The engineering or construction division must provide postdesign or postconstruction services appropriate to the needs of its customers (when required by contract). On-site technical support during construction and dam or bridge inspection services are examples of such servicing. Appropriate records of support-related activities must be maintained and must verify that any required servicing has met the contractual requirements.

**Note:** When USACE is the engineer of record for any project, on-site technical support may be required by regulation.

#### **Guidance**

If required by the contract or regulation, planning procedures for servicing should

- ◆ clarify technical support responsibilities,
- ◆ plan service activities (in-house or externally provided),
- ◆ provide suitable documentation and instructions for support personnel responsible for on-site support,

- 
- ◆ provide backup technical advice, and
  - ◆ provide competent, trained technical support personnel.

## **GUIDELINES FOR CONFORMITY**

- Are procedures established for providing specified services to the customers?
- Where required, are service actions meeting the expectations of the customers?
- Are the appropriate personnel trained for servicing?
- Does the organization perform periodic reviews of completed construction projects to ensure that specific elements function as they were intended?

## **4.20 Statistical Techniques**

### **4.20.1 IDENTIFICATION OF NEED**

#### **Requirement**

The division must determine the need for statistical techniques in the various parts of the project management life cycle.

#### **Guidance**

Statistical techniques can be useful for nearly every aspect of an organization's operation. Among the statistical techniques that may be appropriate are the following:

- ◆ Graphical and statistical methods to help diagnose problems
- ◆ Histograms and Pareto analysis to help establish priorities for dealing with nonconforming products (supports preventive actions)
- ◆ Regression analysis to improve quantitative models for a process
- ◆ Sampling inspection of materials
- ◆ Network analysis of claims for effectively negotiating impact of time delays
- ◆ Measurement of quality system goals and objectives.

#### 4.20.2 PROCEDURES

The division must have documented procedures for implementing needed statistical techniques, where necessary.

#### GUIDELINES FOR CONFORMITY

- Are the needs for statistical techniques identified and used to determine design process capabilities, product characteristics, nonconforming products, test and inspection controls, process controls, and customer complaints?
- Are the process variables and their effects on the finished product understood?
- Are those techniques properly used and reviewed for consistency in application?
- Are all statistical procedures controlled and kept current?
- Are the appropriate personnel trained in the use of the statistical analysis?

## **Appendix B**

# **Questionnaire for ISO 9000 Certification Training and Effectiveness Survey**

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This appendix contains the questionnaire sent to all individuals in Louisville Engineering and Portland Planning and Engineering just after those divisions had achieved certification to ISO 9001. The purpose was to survey managers, engineers, technicians, and administrative employees who experienced the ISO 9000 registration process to develop an understanding about the effectiveness of the training they received and the benefits to their organizations of obtaining ISO 9000 certification. The questionnaire includes an area for respondents to comment on aspects of the certification process not covered elsewhere in the questionnaire.

## **SURVEY OF PILOT USACE DISTRICT PERSONNEL ABOUT ISO 9000 CERTIFICATION TRAINING AND EFFECTIVENESS**

This survey is designed to obtain information that will help the U.S. Army Corps of Engineers decide about the future of ISO certification in the Corps. In particular, the survey asks managers, engineers, technicians, and administrative employees who have experienced the ISO 9000 registration process about the effectiveness of training they received and the benefits to their organization of obtaining ISO 9000 certification. Your honest opinion will be instrumental in evaluating whether ISO 9000 certification is a worthwhile endeavor for the Corps.

Thank you for your help.

## **TRAINING**

**Q-1.** During the ISO 9000 registration process, training was accomplished by many means. Victoria Group, a consultant, provided supervisors with Implementation, Documentation, and Internal Auditor training in formal workshops. Supervisors trained their staff and staff helped their peers. How effective was the training you received?

*Circle the number of your answer for each source of training you received.  
If you did not receive training from a particular source, circle answer 6 "Not Applicable."*

<b><u>Source of Training</u></b>	<b><u>Not Effective</u></b>	<b><u>Slightly Effective</u></b>	<b><u>Effective</u></b>	<b><u>Quite Effective</u></b>	<b><u>Extremely Effective</u></b>	<b><u>Not Applicable</u></b>
<b>Victoria Group</b>	1	2	3	4	5	6
<b>Supervisor</b>	1	2	3	4	5	6
<b>Peer</b>	1	2	3	4	5	6

**Q-2.** Some people also obtained information about the ISO 9000 registration process from materials such as fliers and manuals. These materials were produced by the Victoria Group and your district in both hard copy and electronic media. How effective were the training materials you received?

*Circle the number of your answer for each type of training material you received.  
If you did not receive a particular type of training material ,circle answer 6 "Not Applicable."*

<b><u>Training Material</u></b>	<b><u>Not Effective</u></b>	<b><u>Slightly Effective</u></b>	<b><u>Effective</u></b>	<b><u>Quite Effective</u></b>	<b><u>Extremely Effective</u></b>	<b><u>Not Applicable</u></b>
<b>Victoria Group Manuals</b>	1	2	3	4	5	6

### **District Produced Materials:**

<b>Manuals</b>	1	2	3	4	5	6
<b>Fliers</b>	1	2	3	4	5	6
<b>Electronic Media (PC)</b>	1	2	3	4	5	6

## **ISO 9000 REGISTRATION BENEFITS**

**Q-3.** To what extent do you agree or disagree with the following statements about the impact of the ISO 9000 registration process?

*Circle the number of your answer for each statement. If you do not know the answer to a particular statement, please indicate "Not Applicable."*

<b><u>Statement</u></b>	<b>Strongly Disagree</b>	<b>Disagree</b>	<b>Neither Disagree nor Agree</b>	<b>Agree</b>	<b>Strongly Agree</b>	<b>Not Applicable</b>
<b>Helped me better understand what I do.</b>	1	2	3	4	5	6
<b>Helped my branch better understand what we do.</b>	1	2	3	4	5	6
<b>Helped my division better understand what we do.</b>	1	2	3	4	5	6
<b>Helped people outside my division better understand what we do.</b>	1	2	3	4	5	6
<b>Improved quality of our product.</b>	1	2	3	4	5	6
<b>Improved customer satisfaction.</b>	1	2	3	4	5	6
<b>Made the district more competitive.</b>	1	2	3	4	5	6
<b>Was worth the effort.</b>	1	2	3	4	5	6

**Q-4.** What effect has ISO 9000 registration had on the efficiency of your division in each of the following categories?

*Circle the number that best describes your opinion.*

<u>Category</u>	<u>Significantly Less Efficient</u>	<u>Slightly Less Efficient</u>	<u>No Change</u>	<u>Slightly More Efficient</u>	<u>Significantly More Efficient</u>	<u>No Opinion</u>
<b>Establishing Customer Requirements</b>	1	2	3	4	5	6
<b>Engineering and Design Process</b>	1	2	3	4	5	6
<b>Document Control</b>	1	2	3	4	5	6
<b>Records Management</b>	1	2	3	4	5	6

## **RECOMMENDATIONS**

**Q-5.** Do you recommend ISO 9000 certification for other USACE organizations?

*Circle the number of your answer for each level of USACE organization.*

<u>LEVEL OF ORGANIZATION</u>	<u>YES</u>	<u>NO</u>	<u>NO OPINION</u>
Other organizations within your district	1	2	3
Other USACE districts	1	2	3
USACE organizations above district level	1	2	3

## **PARTICIPANT BACKGROUND INFORMATION**

*Check the one appropriate response to each of the following questions.*

**Your Position:**

- Supervisor  
 Engineer or Technician  
 Administrative or Support

**Length of time since you started your individual ISO 9000 training**

- More than 12 months 1 Year  
 6-12 months  
 3-6 months  
 Less than 3 months  
 I have not received any ISO 9000 training.

## **COMMENTS**

Would you like to comment on your answers to any of these questions or provide other suggestions about the ISO 9000 process or your experiences with it which would help HQS USACE to decide about its future use in the Corps? If so, please use this space (and additional sheets as necessary) for that purpose.

Results from this questionnaire will be included as a major input to the pilot study report providing recommendations to Headquarters USACE. Copies of the report will be provided to your office when complete. Your contribution to this survey and your effort in this pilot program is greatly appreciated.

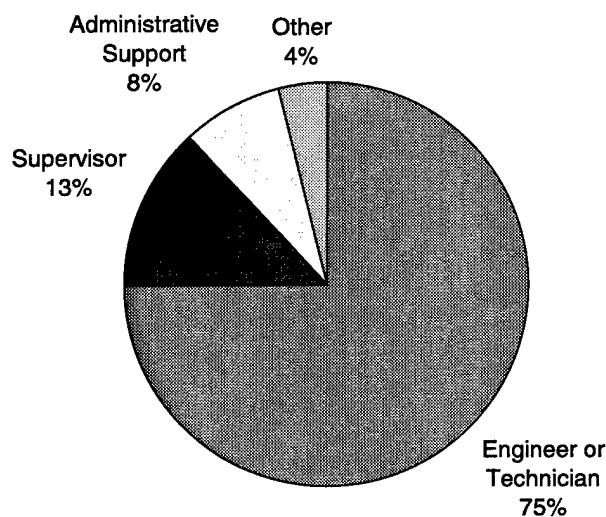
## Appendix C

# Results of ISO 9000 Certification Training and Effectiveness Survey

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LMI received completed questionnaires about the ISO 9000 certification training and effectiveness from 218 respondents. Of them, 131 were from Louisville Engineering, and 87 were from Portland Planning and Engineering. As Figure C-1 shows, 75 percent of the respondents were engineers or technicians. More than 60 percent of the respondents indicated that they had received their ISO 9000 training 6 months or more before they responded to our questionnaire.

*Figure C-1. Distribution of Positions Held by Respondents*



We entered the responses into an Access database, then imported the data into SPSS for Windows (Version 7.5) for statistical analysis. For each of the five key survey questions, we developed distributions for three groupings of respondents: all respondents; respondents by position (supervisor, engineer or technician, and administrative or support personnel); and respondents by time since they had received ISO 9000 training.

In our analyses, we used measures of central tendency to define the nature of the various distributions. These measures include the mean, median, standard deviation, and variance. We also applied measures of kurtosis and skewness to the

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histograms to develop an understanding of the normal curves, or the shape of the distributions. To understand the most frequently chosen response for each question by each of the three groupings of respondents, we used a mean ranking. In selected cases, we used one-way analysis of variance (ANOVA) to determine the extent to which the difference in the mean values within groups were significant.

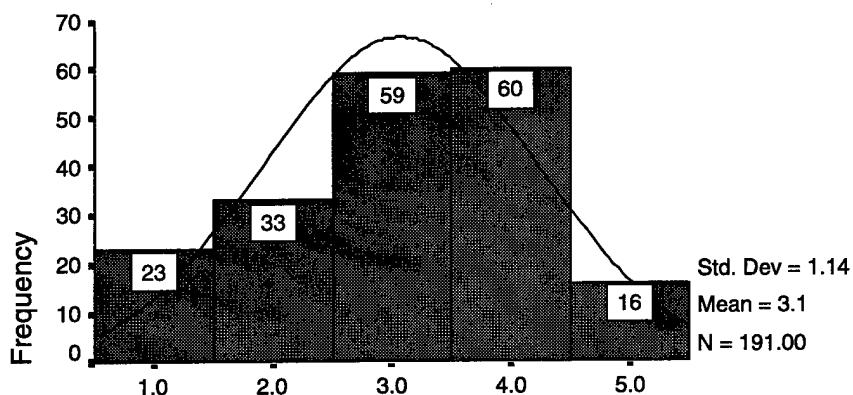
This appendix summarizes the results of our analyses. The results are instructive in that they illustrate perceived benefits and efficiencies achieved as a result of certification and rate the effectiveness of the training techniques and materials used during the process. However, given the distribution of respondents by position, the survey results are heavily influenced by engineers and technicians.

## KEY RESULTS

The most important questions (Questions 3 and 4) concern the extent to which respondents agreed with statements about the impact of ISO 9000 registration on the organization and the effect that ISO 9000 registration has had on certain aspects of organizational efficiency. When analyzing the answers to these questions, we took a mean ranking of responses to determine which statements respondents viewed most favorably:

- ◆ Of eight possible choices in Question 3, all respondents agreed most favorably with the statement that the ISO 9000 registration process “helped my division better understand what we do.” The distribution for this response is shown in Figure C-2.
- ◆ When considering the question about the effect ISO 9000 registration has had on the efficiency of four categories within the division, respondents rated document control as having experienced the greatest improvements. The distribution for this response is depicted in Figure C-3.
- ◆ In every category of Questions 3 and 4, supervisors responded with greater approval with regard to the perceived benefits of ISO 9000 registration and were more optimistic about the extent to which the ISO 9000 registration process helped the organization achieve efficiencies.

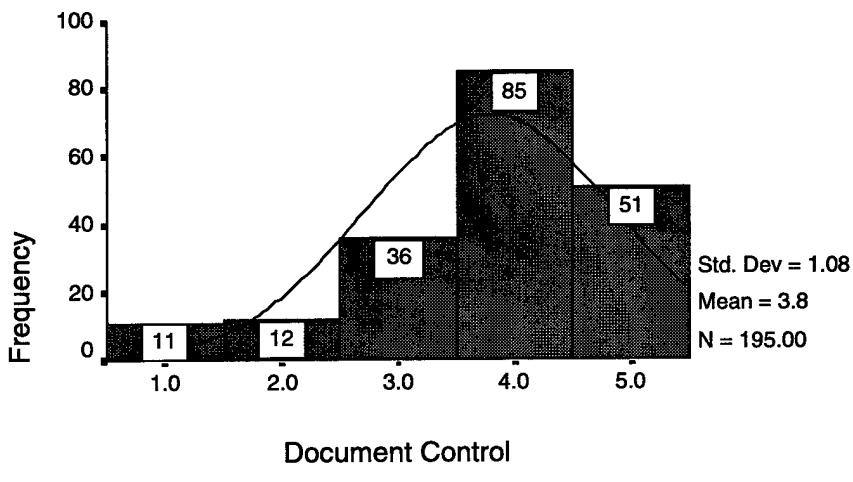
*Figure C-2. Impact of ISO Registration Process—  
Highest Ranked Statement*



Helped My Division Better Understand What We Do

1=strongly disagree <--> 5=strongly agree

*Figure C-3. Effect of ISO 9000 Registration on Efficiency—  
Highest Ranked Efficiency Improvement*



Document Control

1=significantly less efficient <--> 5=significantly more efficient

The remaining sections discuss the results in more detail.

## PERCEIVED BENEFITS

Question 3 focused on the extent to which respondents agreed with several statements provided in the survey. Table C-1 displays the mean responses to these statements, split by respondent groupings (supervisors, engineers and technicians, and administrative and support). In this table, we used a one-way ANOVA to identify the statements for which the difference in responses among the groups was significant. Several of the statements have a less than 1-in-100 chance (0.01)

of having the same mean score. Generally, scores of more than .05 indicates that there is no significant difference in mean scores.

*Table C-1. Mean Ranking of Statements About the Impact of the ISO 9000 Registration Process*

Statement	Overall		Supervisors		Engineers/ technicians		Administrative/ support		One-way ANOVA	
	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	F	Sig.
Helped my division better understand what we do	1	3.07	1	3.93	4	2.91	1	3.44	9.40	.000
Was worth the effort	2	3.06	2	3.93	3	2.93	7	3.00	6.03	.001
Made the district more competitive	3	3.06	5	3.64	2	2.94	2	3.13	2.85	.038
Improved quality of our product	4	3.03	4	3.68	1	2.94	4	3.12	4.31	.006
Helped my branch better understand what we do	5	2.92	3	3.75	5	2.78	5	3.06	6.62	.000
Improved customer satisfaction	6	2.84	7	3.46	7	2.72	3	3.12	4.60	.004
Helped me better understand what I do	7	2.83	6	3.61	8	2.71	8	3.00	5.56	.001
Helped people outside my division better understand what we do	8	2.79	8	3.07	6	2.74	6	3.00	1.30	.275

Notes: F = F-statistic; sig. = significance.

## PERCEIVED EFFICIENCIES ACHIEVED

Question 4 focused on the extent to which ISO 9000 registration had an effect on efficiencies in selected categories. Table C-2 displays the mean responses to these categories, split by respondent groups. Again, we used a one-way ANOVA to identify the categories for which responses among groups differed significantly. As the table shows, responses differed from group to group, but the difference in mean scores for document control and records management are not significant.

*Table C-2. Mean Ranking of Effect of the ISO 9000 Registration Process on Efficiency*

Statement	Overall		Supervisors		Engineers/technicians		Administrative/support		One-way ANOVA	
	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	F	Sig.
Document control	1	3.78	2	4.15	2	3.72	1	3.93	1.46	.227
Records management	2	3.77	1	4.15	1	3.73	2	3.69	1.46	.227
Establishing customer requirements	3	3.42	3	3.96	3	3.36	4	3.08	6.65	.000
Engineering and design process	4	3.13	4	3.65	4	3.07	3	3.25	4.56	.004

Notes: F = F-statistic; sig. = significance.

## OTHER IMPORTANT RESULTS

While the more critical aspects of the survey are covered in Questions 3 and 4, a few other observations should be made:

- ◆ When asked about the effectiveness of ISO 9000 training, respondents rated three sources. A mean ranking indicated that the most effective source of training was the Victoria Group. Supervisors and peers, respectively, were the second and third most effective sources of training.
- ◆ Respondents also were asked about the effectiveness of four types of ISO 9000 training materials. The mean ranking indicated that the most effective were Victoria Group manuals. The other types, in order of effectiveness, were district electronic media, district manuals, and district fliers.

Overall, respondents were evenly divided when asked whether they would recommend ISO 9000 certification for other USACE organizations (Question 5). However, analysis of the responses by position of the respondents showed that supervisors strongly recommended certification for other USACE organizations.

## Appendix D

# Survey of Sites in Pilot Program

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### INTRODUCTION

In February 1998, LMI sent questionnaires to the four engineering and two construction divisions participating in the ISO 9000 pilot program. The questionnaire had 24 open-ended questions covering the entire process used to prepare for ISO 9000 registration, from the organization phase to the final external audit for registration (if registration had been achieved by the survey date).

In this appendix, we provide the responses made by Savannah Construction, Louisville Construction, Louisville Engineering, and Portland Engineering to our questions. (Savannah Engineering and Kansas City Engineering did not respond to the questionnaire). The responses have been edited slightly for style, clarity, brevity, and grammar.

### QUESTIONS AND RESPONSES

1. When did you start preparing for ISO 9000 registration?

*Savannah Construction:* The first training effort to prepare for implementing ISO 9000 in the Savannah District took place in February 1996. Serious effort on implementing ISO 9000 began in May 1996. The goal in Savannah was to implement the quality standards, not necessarily achieve registration. We did not understand achieving registration to be the primary goal from our communications with USACE headquarters, LMI, or the Victoria Group.

*Louisville Construction:* In the spring of 1995.

*Louisville Engineering:* Our first training (ISO Implementation Workshop) was conducted in March 1995.

*Portland Engineering:* Unofficially in June 1995 (prior to HQ funding); officially in October 1995.

2. When did you achieve registration? If not yet registered, when do you project achieving registration?

*Savannah Construction:* Anticipate being ready for an extrinsic audit in June 1998.

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*Louisville Construction:* No. Preassessment audit will be performed in February/March 1998. Pending the outcome of this audit, the registration audit may be scheduled in June/July 1998.

*Louisville Engineering:* The Louisville District Engineering Division was registered on 27 March 1997.

*Portland Engineering:* August 1997.

3. Thinking of the elapsed time between 1 and 2 above, how much calendar time was spent between three broad categories of activity: (1) organizing (figuring out what you had to do), (2) reviewing processes/procedures and preparing documentation, and (3) implementing your new quality management system?

*Savannah Construction:* (1) 6 months, (2) 12 months, (3) 7 months to allow two rounds of internal audits.

*Louisville Construction:* (1) Approximately 14 months, (2) Approximately 17 months, (3) Approximately 2 months.

*Louisville Engineering:* (1) 6 months, (2) 10 months, (3) 3 months.

*Portland Engineering:* (1) 7 months, (2) 5 months, (3) 3 months.

4. What was the division's organizational structure at the time you began? Has it changed since? (Please attach organization chart.) If so, did the change result from the process analysis during preparation of your ISO 9000 documentation? What is your FTE authorization?

*Savannah Construction:* Organization has not changed significantly in this time period other than disestablishment/establishment of field offices because of workload changes. I would not anticipate any significant organizational changes because of ISO 9000. There are simply too many other factors involved. FTE authorization is 253, military and civil.

*Louisville Construction:* Fewer people, but organizational structure is the same. (Organizational chart is attached.) There have been no changes to organizational structure because of ISO. Our FTE authorization, based upon affordability, is 43.99 for civil works and 119.48 for military (as of 20 Dec 97).

*Louisville Engineering:* Our current FTE is approximately 220. Our organization has changed, but the primary motivation for change was not the result of ISO. We are in the process of focusing on a Quality Officer position.

*Portland Engineering:* A.) No change in the physical makeup of the organizational chart. B.) One branch was moved to another division (move was predetermined, not because of ISO implementation). C.) No changes occurred as a result of ISO implementation/documentation. D.) Approximately 160.

5. Tell us how your division approached the assignment, i.e., did you approach the task of preparing for registration as a project?

*Savannah Construction:* We initially approached the task of implementing ISO 9000 as a project. It was simply another thing to be done and was not embraced as a fundamental change in our business process.

*Louisville Construction:* Yes. The management team was formed and a management representative was appointed by the division chief. Training on what ISO is followed formulation of team. Assignments for drafting the various procedures was given to groups of employees. Training of internal auditors was provided last.

*Louisville Engineering:* We relied very heavily on the services of the Victoria Group to lead us through the process, but we established a schedule to obtain registration, identified the major milestones necessary to accomplish it, and handled the process similarly to the development of a project.

*Portland Engineering:* With the help of a consultant (Victoria Group), an approach to an business operations model was formulated and then implemented.

6. What was the management structure for the project (DE down to management representative)?

*Savannah Construction:* The management representative was tasked with implementing ISO 9000. There was little daily management involvement above this level.

*Louisville Construction:* District engineer, division chief, management team, and management representative constituted the order of management structure set in place for implementation of ISO.

*Louisville Engineering:* We identified a management representative (assistant chief of engineering), program manager (chief of QA section), and the remaining membership of the management team (chief engineering, branch chiefs, and chief of management support section). There was no role of district staff outside of Engineering, with the exception of the Internal Review Office, which reviewed our procedures.

*Portland Engineering:* Management structure was primarily confined solely to Planning and Engineering, with the management representative being appointed from one of the existing managers.

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7. What was the organizational position of the person designated as the management representative? Was this particular person selected based on position, ability, availability, or what?

*Savannah Construction:* Organizational position is that of section chief, GM-13. The factors indicated to be involved in the selection were: position (current position already involved significant duties with direct ISO 9000 application), availability and individual's ability.

*Louisville Construction:* The management representative is the chief of quality assurance. Since ISO is a quality system, logically the position went to the person responsible for quality in the organization.

*Louisville Engineering:* Selection was based on position and ability. We wanted an individual from management high enough in the organization to create the proper image for the overall effort. The total process required the efforts of numerous staff during the development phase and the cooperation of all staff during the implementation phase, and without the proper emphasis at the senior management level, we did not feel we could succeed.

*Portland Engineering:* Chief, Technical Resources Branch. Supervisory position, ability and availability, no lower than branch chief level.

8. Did anyone work on the task full time? If so, what was their job (position) before undertaking this assignment?

*Savannah Construction:* There was no one assigned to work on ISO 9000 full time for the entire period. There were a couple of 2- to 3-month periods when a person was assigned to work on this task solely.

*Louisville Construction:* No. However, separate drop codes were established to capture employee efforts on ISO.

*Louisville Engineering:* No one worked full time on this initiative.

*Portland Engineering:* Yes, ISO coordinator; Chief, Contract Administration (Construction).

9. What team structure did you put in place to prepare the documentation?

*Savannah Construction:* Basic structure was developed by the management representative. Individual procedures in support of ISO elements were assigned to several task groups. SOPs (level 3 documents) were assigned to CD offices that were already proponents for the various processes.

*Louisville Construction:* The management team members are all supervisors from the management positions in the division. Teams for writing procedures were

hand picked from all employees in the division based upon their knowledge of the subject. At least one existing supervisor (not necessarily on the management team) was placed on each procedure writing team as a leader. However, one procedure writing team contained no supervisors and worked well.

*Louisville Engineering:* Following our gap analysis, we decided what additional guidance documents were going to be required. We identified the need for additional guidance/procedures in 21 different areas. A leader for the development of each new quality procedure document was selected from the management team and a quality action team was assembled to prepare the required documents. Several teams were assigned to cover multiple areas when there was a natural relationship between those areas. Total staff involved in the preparation of these documents was approximately 40.

*Portland Engineering:* No formal team structure was used to prepare the documentation. Branch chiefs and a few other key people performed brainstorming and preparation of the quality manual.

10. How many groups/people actually worked on drafting materials for the quality manual? Did you have an editor and production team preparing final documents?

*Savannah Construction:* There were approximately 15 people who worked on drafting procedures. There was no editor/production team set up. There was an approval process developed and the management representative reviewed and signed off on every document, not necessarily for content but to ensure that it fit into the quality system.

*Louisville Construction:* Fifteen groups of people worked on drafting the procedures. The number of people working on writing the procedures was 42 within the division and 1 outside the division. The management representative, with the help of three consultants and one contracted employee, edited and produced the controlled ISO procedures.

*Louisville Engineering:* See response to Question 9. One team of approximately 4 members prepared the quality manual. A similar process was used for each EQP developed. During the development phase, procedures were being reviewed monthly by Victoria Group/LMI. Mr. Jinks came to the Louisville District on numerous occasions to review the documents. In addition Mr. Hawkins had the staff of LMI perform an editorial review of the documents. When we believed the documents were near final form, each member of the management team reviewed the entire package.

*Portland Engineering:* Over a dozen personnel were involved in generating the quality manual. In a manner of speaking, the management representative, ISO coordinator, and staff reviewed, edited, and commented.

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11. Please explain your document control system for the preparation of the quality manual and work instructions.

*Savannah Construction:* See procedure CQP 5-01 and excerpts from the quality manual, which are attached. These documents can also be viewed at [www.sas.usace.army.mil/cd/cdnet](http://www.sas.usace.army.mil/cd/cdnet).

*Louisville Construction:* The quality system has been placed on the division's intranet and will be maintained by one of the division's branches. This will be the "controlled" copy.

*Louisville Engineering:* The preparation of the quality manual was accomplished by one of the quality action teams, and Mr. Sommerville served as the leader of this effort. The preparation of all EQPs were handled in a similar fashion. As documents were nearing completed status, they were made available on our LAN system, but each page of each document carried the following footnote: (UNCONTROLLED DOCUMENT REVIEW COPY ONLY). Not until the document was approved and subjected to the signature process described in EQP-5-01 (Procedure for the Preparation and Administration of Procedures) was this footnote removed. Altogether we generated a total of 36 EQPs (now 37) in addition to the quality manual. Numerous other existing documents were converted into work instructions with a similar but less stringent process. This process is also described in EQP-5-01. All new documents, as well as any changes that have resulted since initial implementation, are accomplished through a process we call implementation memorandums, which are e-mailed to all Engineering staff. These memorandums serve as official notification of implementation. Records of official implementation of the current version of every internally generated document can be traced to an implementation memorandum.

*Portland Engineering:* The quality manual consists of two parts (Part 1 Policy and Part 2 Procedures), and it applies throughout Planning and Engineering. A policy statement was created for each ISO 9001 element; procedures were drafted to document the business operating system as we know it. Policy is cross-referenced to associated procedures. Work instructions were left for individual sections or branches to create and maintain on their own and do not apply to the rest of the division. One copy of the quality manual was assigned to each branch and section chief and to each internal auditor.

12. From where within the district's organization did you select your internal auditors?

*Savannah Construction:* All auditors are members of the Construction Division.

*Louisville Construction:* One of the division's branches was already performing quality assurance team visits to field offices. This branch now performs the internal audits. So, an existing system already in place was adopted. For the

division office, the district's Internal Review Office performs the internal review of the division office.

*Louisville Engineering:* We utilize our Internal Review Office for this effort. From a district organizational structure, this office is on the same level as the Engineering Division or any other division within the Louisville District. We also had some of Engineering's staff trained in auditing, but have not yet officially used them to perform this function. We plan to assist Construction in this effort.

*Portland Engineering:* Approximately one individual per section.

13. How did you train your entire work force to become familiar with the ISO 9000 program and their part in it?

*Savannah Construction:* We put together a training program and trained all in the Construction Division. Training materials can also be viewed at our Web site.

*Louisville Construction:* The division chief and his management representative went to each field office location and held 4 hours of training or orientation on ISO.

*Louisville Engineering:* We provided numerous ISO orientation sessions, provided several other training sessions, and utilized e-mail communication to educate and explain the overall process. Numerous e-mail messages in the context of training were issued to Engineering staff. We asked all staff to demonstrate their support for the overall initiative by signing a poster-sized copy of our quality policy. Basically we ran an advertisement blitz during the entire process. In addition we furnished a brochure to each employee to explain the process and give questions/answers.

*Portland Engineering:* Town hall (staff) meetings with the division chief, management representative, and ISO coordinator. Numerous meetings with individuals, sections, and branches. Internal auditor training and internal audits also served to familiarize staff with ISO-based requirements.

14. How much money (direct and indirect) did you spend preparing for registration?

*Savannah Construction:* Approximately \$350,000, give or take. Some costs may have been lost during CEFMS blackout. Also, this figure includes costs for revamping our existing SOPs, which we would have had to do whether we were implementing ISO or not.

*Louisville Construction:* The final costs are not in. It is expected that our cost will round out somewhere near to \$125,000. Costs paid to the consultants sponsored by OCE are unknown.

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*Louisville Engineering:* The information presented below represents a summary of various reports and requests for information that Louisville district has provided to our higher command during the entire process; it also provides additional information covering several other questions contained in your request.

A. Schedule for implementation; progress made.

ORL's schedule for implementation is as follows:

Training started	Mar 1995
Gap evaluation	Jun 1995
Fill-in gap training	Nov 1995
Up and running	Apr 1996
Officially implemented	Jul 1996
Documentation review	Sep 1996
Preassessment audit	Oct 1996
Certification audit	Jan 1997
Received certificate	Mar 1997

B. Cost to date for implementation and estimated cost to complete.

Labor costs above normal costs of operation:

FY95	\$25,000
FY96	\$150,000
FY97	\$15,000
Total labor cost	\$190,000

Registrar contract      \$25,000

C. Lessons learned to date including a best estimate of value that will be added by implementation of ISO 9000.

After having gone through this process, we feel very positive about the experience. While we thought we were doing quality work before, we discovered numerous areas that needed improvement and have already implemented many of these initiatives.

While the cost was not cheap, we feel the benefits will far exceed the expense. When you are forced to look at your overall operating system in comparison to the 20 elements of the 9001 standard, it becomes painfully obvious how inconsistent and mistake prone your normal procedures have been. ISO 9000 is just good business practice. It does not represent nice-to-have features but basically represents the minimum requirements needed to consistently produce a high-quality product. An argument can be made that registration is not required because the same benefits can be achieved by just implementing the procedures. While in theory this may be

true, the Louisville District has experienced great benefits from having gone through the process and facing the very stringent challenge of passing the registration process. Merely trying to implement the procedures, without planning to seek registration, would make this process just another management program with no real incentive for success. Registration forces all district staff to endorse the goal and, once obtained, to maintain it. Follow-up audits ensure that your procedures are continually followed. They will keep your efforts honest and will not allow regression into old habits.

D. A statement of how ISO 9000 has (or will) mesh with the present system of QA being performed by MSCs.

ISO 9000 does not contradict, or negate in any way, current QC/QA activities. In some cases, 9001 requirements go beyond MSC requirements, but these only reinforce the goal of producing high-quality products. The only problem we have had in trying to mesh the two systems has been in terminology and definitions. We have to be careful in terminology used in our procedures and work instructions.

E. Any general comments.

Do not try to short-cut the effort required to develop the documentation requirements of ISO 9001. Without going through this step, you will never get a full handle of your organization's quality operating system, and the whole process will become just a paper exercise without the learning experience. We cannot overemphasize the importance of this process and why it is necessary. Until ORL went through this process (which included many cycles of trial and error), we never really fully understood what ISO 9000 was all about. It is this process that will turn unbelievers into proponents of the system. ISO 9001 is a minimum quality system. It is just another piece in our TQM initiative. Without this in place, it is impossible to see how we can strive for an APIC type organization. Our recent APIC "gap" analysis has indicated this.

*Portland Engineering:* Approximately \$264,000.

15. What problems have you encountered since achieving registration?

*Savannah Construction:* Not applicable.

*Louisville Construction:* Not applicable.

*Louisville Engineering:* There is a tendency to relax after the flurry of activity required to obtain the registration. The natural tendency is to focus on obtaining registration rather than on the creation of and adherence to a quality operating system. It is difficult to keep people motivated toward continual compliance, but

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we are making progress. At first there were problems dealing with DL, but these problems have been corrected and now DL is using some of our ISO procedures.

*Portland Engineering:* Maintaining momentum at a high energy level of involvement, interest, and support.

16. How have you kept your internal auditors trained and effective?

*Savannah Construction:* We have had follow-up audit training (given by Paul Jenks) and have gained experience by conducting 15 internal audits to date.

*Louisville Construction:* Internal auditors were trained by the Logistics Management Institute, McLean, VA.

*Louisville Engineering:* Internal audits are accomplished through our Internal Review Office. Individual auditors are each professionally trained. Other than expertise maintained through the frequent audits that they continue to provide to the Engineering Division, no additional training specifically tailored to ISO requirements is being conducted.

*Portland Engineering:* Yes (as well as OJT). A mock preassessment was conducted by our consultant to disclose any large weaknesses in our internal audit system.

17. How have you kept the division's work force trained in the application of your ISO program (assuming new hires, the usual staff rotation)?

*Savannah Construction:* Part of our employee indoctrination routine is ISO 9000 orientation. This is covered in our CQP 18-02. The materials located on our Web site are used by the supervisors to conduct this orientation.

*Louisville Construction:* It is the responsibility of the supervisors to familiarize their new hires on the ISO quality system.

*Louisville Engineering:* We provide ISO orientation to new staff. We perform quarterly project reviews of all ongoing projects, and this serves as a good forum for reinforcement of ISO requirements and allows management staff to evaluate the level of understanding and practice of ISO requirements. Additional training or refresher training may be scheduled if warranted. As also covered in response to Question 13, we utilize our e-mail system to notify all staff of new or revised procedures. During orientation training for new employees, some of our previously trained staff have chosen to also attend as a refresher.

*Portland Engineering:* Yes, new hires included. Have recently initiated weekly sessions with each office to discuss quality manual changes and developments.

18. If you had it to do all over again, what changes would you make to the process you used to prepare for registration?

*Savannah Construction:* One or more bodies would be assigned full time. There would also be a greater commitment of resources. Funds and FTEs would be requested to implement ISO 9000 without robbing from our ongoing work. Would also involve the district commander.

*Louisville Construction:* It is believed most would simply say, finding more time to work on ISO would have made the process go faster. However, time is a premium.

*Louisville Engineering:* We would probably use a very similar process. There may be some training costs that could have been eliminated, but overall the process we followed worked well.

*Portland Engineering:* Make better use of the consultant (Victoria Group); initiate weekly discussions at an earlier stage of quality system development; “live the system” longer; and perform mock audits by the consultant before any official third-party assessment.

19. Do you believe that it would be practical for more than one division within a district to work toward achieving registration at the same time under one certificate?

*Savannah Construction:* Only would work if the district commander was strongly behind it and demanded results. Otherwise stovepipe issues would be very difficult to overcome. Allocation of resources also becomes increasingly problematic.

*Louisville Construction:* Yes.

*Louisville Engineering:* Even though we are aware that other districts are attempting to cover other functions in addition to engineering under one certificate, we do not think this would be practical unless those functions were under the responsibility of the same division chief or the management representative was located at the executive office level. Even if this were the case, it would be imperative that the assigned management representative take a very active role in the development process. The stovepipe mentality has to be eliminated.

*Portland Engineering:* Unless there is unanimity between the divisions, a single division at a time is more manageable, then work toward adding offices, ultimately to district level.

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20. Has the ISO 9000 program resulted in any savings to date? If so, how measured?

*Savannah Construction:* It is premature to try to measure savings as of this date. We implemented our ISO 9000 system on 7 Oct 97 and have only conducted one round of internal audits to date. We have found some problems that are being addressed. This should lead to increased efficiency but cannot be quantified as of yet.

*Louisville Construction:* We feel that for the first time we now have all that we do under one document. That is a benefit. And by using the intranet, all ISO references (ARs, ERs, EPs, CEGS, etc.) are linked to these documents for ready reference. This eliminates the need for hard copies on a file shelf and the question of whether or not they are up-to-date. The benefits have not been measured.

*Louisville Engineering:* We have not taken the time yet to quantify savings, but we believe the process has increased the general awareness of quality, helped tie down customer expectations, and facilitated the communication of these expectations. We see more work coming from DPWs, we use the process in filling our commitments, and it serves as a basis for making management decisions on staff, training, etc. It has become a basis for our business.

*Portland Engineering:* Incalculable with time and effort saved. Documentation initially decreased but has effectively maintained a value-added level since ISO implementation.

21. Do you have any performance measures in place to measure quality, savings, or improvements in efficiency on a regular basis? If so, what are they?

*Savannah Construction:* We have developed a set of audit points and a database to track the audit results. With these two tools, we can now do some statistical quality control on how well we implement our processes. This will allow us to track progress by audit point, by process, by office, etc. We never had this type of tool before.

*Louisville Construction:* Since this division provides a service, not a product, the management team decided to use the existing performance indicators required by higher authority to measure quality. Other performance measures are the existing quality assurance plans for the field offices and efforts to seek customer feedback. Becoming more efficient in what we do, through continuous improvement, is the savings.

*Louisville Engineering:* We are not yet in a position to be able to quantify the long-term benefits of being ISO 9000 registered, but the information listed in response to Question 14 was our general assessment as of early summer 1997. One additional observation is that the Louisville District controllable cost growth for the military construction program dropped from 4.4 percent in FY96 to 2.1

percent in FY97. Although we certainly do not claim full credit from ISO 9000, we do believe that our registration efforts contributed to this drop.

*Portland Engineering:* Command management review measures and customer surveys are regularly used.

22. What are the positive benefits of managing using the ISO 9000 framework?

*Savannah Construction:* It imposes an order and discipline to our overall management. The comprehensive audits identify problem areas that the system then requires be addressed. This requires analysis of the problem and institution of rewrites to our procedures, additional training being provided, etc.

*Louisville Construction:* Some benefits are mentioned in the answer to Question 20. Another benefit is the synergy we all felt with the management of the division pulling together toward this common goal, ISO registration. We most definitely are working better as a team. Once we obtain registration, we will no doubt observe other benefits.

*Louisville Engineering:* See the response to Question 14 above.

*Portland Engineering:* Procedures are more definitive and readily understood. If deviations occur, the quality manual is consulted for correct use. Improved knowledge and clarity of process, better customer coordination, consistency, and mandated management support and required proof of quality control effort.

23. What were the negative aspects of the program?

*Savannah Construction:* It is change, and a lot of people do not support change of any type. It is also more resource intensive to implement (but probably not to maintain) than we ever thought it would be.

*Louisville Construction:* Cost.

*Louisville Engineering:* Other than the initial costs, we cannot identify any other negatives aspects. Our primary customer (PPMD) has complained that we require too much information in order to begin initiating action on their requests. We believe the information we request is merely information that the regulations require them to gather in the initial phase of a project, which typically was ignored in the past and sometimes continues even now to be ignored. Our insistence on having a defined scope of work is merely requiring them to fulfill an existing requirement that before was sometimes being ignored in the name of providing quick execution. This is an example of us discovering how our previous practices were less than satisfactory and frequently resulted in a dissatisfied customer because of failure to insist on a defined and mutually accepted project scope.

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*Portland Engineering:* None, save comments such as “how much did you save” and “what are the dollar savings for your effort.” ISO implementation is a continuous process, and long-term effects are not readily recognized or discovered in manifest ways.

24. What suggestions do you have for other districts considering pursuing registration?

*Savannah Construction:* (1) Get buy-in from senior management up front. (2) Sell the benefits to all. (3) Commit the necessary resources to get a system in place in less than a year. (4) Learn all that you can from the first districts that tried this.

*Louisville Construction:* Follow the footsteps of those who have gone before you. Obtain copies of their written quality systems and rely on their experiences in developing your own system. Speak/meet with those who have “been there, done that,” and build on those experiences.

*Louisville Engineering:* We recommend registration. One of the primary benefits, however, is the process leading up to registration not just obtaining the certificate. Without the knowledge and insight gained by going through the process, benefits would be greatly reduced. We are convinced that without going through the growing pains, a district would never really understand its own processes and never become aware of vulnerable areas. We do not believe that a “poor-man’s-ISO” would work because, without the continual incentive of having to undergo surveillance audits, any firm would tend to slip back into old patterns of work that do not meet the minimum requirements of the standard. It is imperative that the executive level strongly believes and supports the ISO quality program for it to be successful.

*Portland Engineering:* Retain a good consultant who understands your business operating system and can provide a perspective of ISO requirements with that system. Do not “buy” your registration through a third-party consultant; it only works if you do it yourself; you need to *own* the system. Do it if you think you will benefit in the long term!

# REPORT DOCUMENTATION PAGE

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<b>13. ABSTRACT (Maximum 200 words)</b>  The U.S. Army Corps of Engineers wants to ensure that it continues to deliver quality products and services to its customers well into the future. The Corps concluded that the best tool to achieve its goal is the ISO 9000 quality management system. To test the concept of operating under an ISO system, USACE selected four engineering and two construction divisions for a pilot program. This report assesses that program. The study concluded that ISO 9000 offers valuable benefits to the Corps: postregistration operations are more efficient. Less tangible, but equally worthy, is the effect of ISO 9000 on morale. The divisions operating under the ISO quality system have improved internal communication, increased teamwork, improved the ability of individuals to see the big picture, reduced the time required to deal with routine procedures, clarified responsibilities, and reduced errors. The report notes a number of lessons learned from the ISO 9000 registration process used in the pilot program and recommends a number of specific steps that USACE can take to make the process more efficient and less costly, thus facilitating the implementation of ISO 9000 throughout the Corps.				
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